

SCIENTIFIC AMERICAN

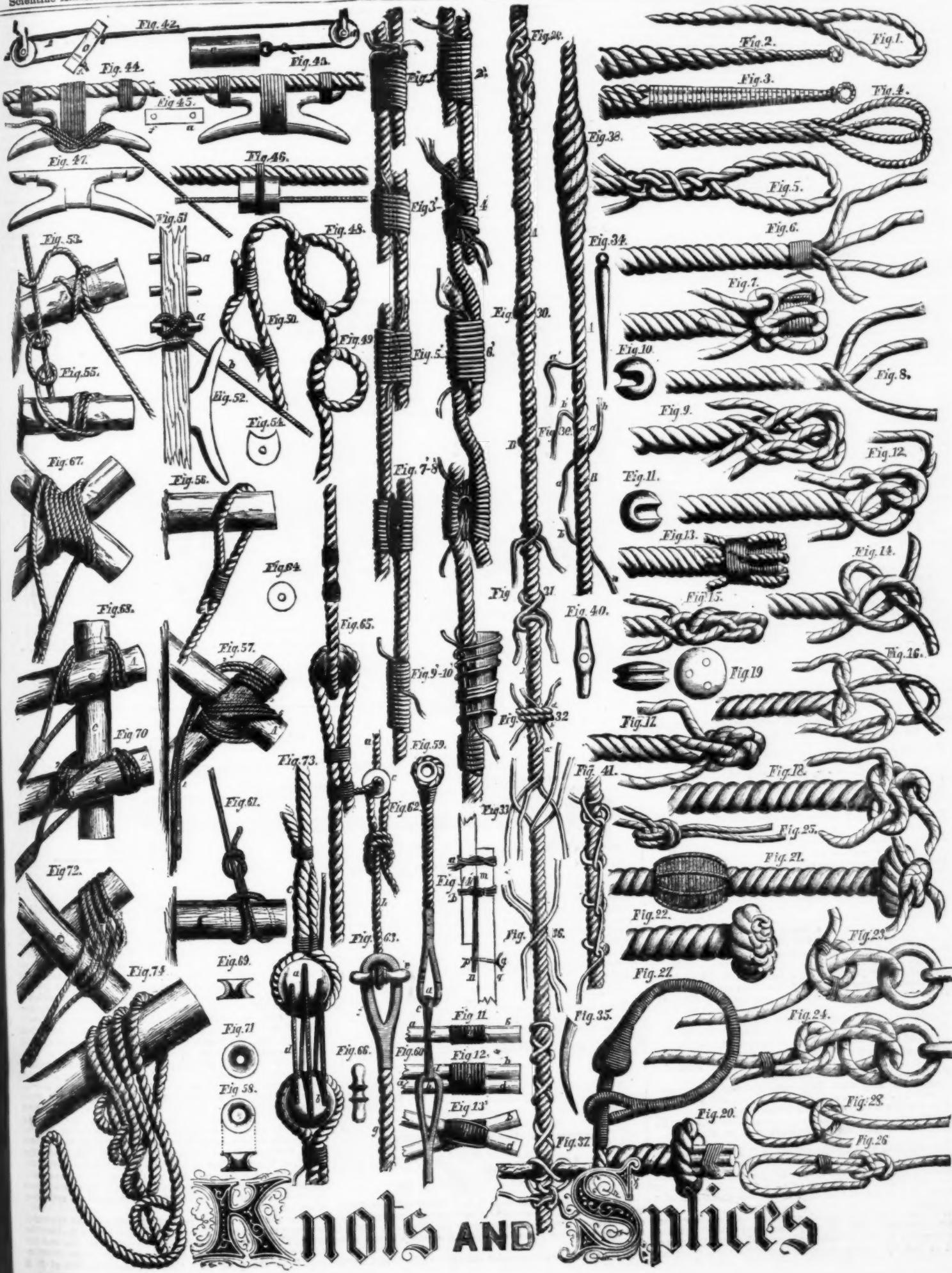
NO. 319.

Scientific American Supplement. Vol. XIII. No. 319.
Scientific American, established 1845.

NEW YORK, FEBRUARY 11, 1882.

319

Scientific American Supplement, \$5 a year.
Scientific American and Supplement, \$7 a year.



KNOTS AND SPICES

HIGH SPEED STEAMSHIPS.

The proposals which have recently been put forward for the construction of a fleet of high speed Atlantic steamers, the launch of the City of Rome, the building of gigantic ships by the Guion and Cunard companies, all point the same way, and indicate the existence of a desire to place England and America virtually yet closer together than they are now. In certain respects the problem to be solved is very simple. Most of the conditions to be fulfilled are perfectly understood. An average speed of at least twenty miles an hour must be maintained incessantly while a storm-swept ocean, 3,000 miles broad, is being traversed. It is known that there is no possibility of doing this with vessels of less than 5,000 tons displacement, and it is nearly certain that much more will be required. An average speed of twenty miles means that a higher velocity than this must be attained now and then when wind and sea are not dead against the ship. Thus it comes to pass that the express Atlantic steamer of the future must be a vessel of enormous engine power. We have already pointed out the great difficulties that stand in the way of utilizing 14,000 or 15,000 indicated horse-power at sea. It will be readily conceded that, although the conditions of success are, as we have said, known, the means of securing these conditions have not been settled. It is evident, however, that it is of the utmost importance that the resistance of the ship should be as small as possible. Now the late Mr. Froude taught the world a lesson which has often been misunderstood. He pointed out that the form of a ship's hull had little or no effect on the power required to propel her, and in saying that he was quite right in one sense; but he did not stop there. He added that eddy making was the great source of resistance, and eddy making depends very much indeed on the shape of a hull. To eddies and skin friction the whole, or very nearly the whole resistance of a ship may be attributed, but these are both largely dependent on the shape of a ship's hull. Now it is not perhaps too much to say that no further progress is possible in the direction of reducing the resistance of ships so long as we adhere to existing models. The London and Northwestern Railway Company's Holyhead steamer Violet is probably at this moment the fastest steamship in the world. She has attained a velocity not much less than that of torpedo boats, but no express Atlantic steamer could be built like her. The Violet is a paddle boat, and what will suit paddles will not answer for screws. A new departure is necessary.

A design prepared by Captain C. G. Lundborg, of Sweden, a naval architect, appears to us to be full of promise. It has been argued that the design is not a good one for a cargo steamer, and we concede at once that it is not worth while to build a steamer of this type to attain a speed of eight or nine knots. The design is for an Atlantic passenger steamer, which, while affording ample space for passengers and valuable cargo, has been prepared with the primary object of attaining a velocity of twenty to twenty-one knots an hour, with a comparatively moderate expenditure of power. The prominent idea involved is that of making the main body of the ship divide the water horizontally instead of vertically. It will perhaps be conceded without much hesitation that by adopting this system of construction it becomes possible to build a ship of the greatest capacity for a given draught—an advantage which speaks for itself. But besides this it is also evident that this ship of shallow draught and great capacity can have admirable lines. In other words, her resistance may be reduced to a minimum. The principle admits of the naval architect imparting to his ship a splendid clean run aft, and the screws can be carried far astern and yet be perfectly supported. The advantages to be derived from thus placing the screws far astern have been insisted on by the late Mr. Froude. It will also be seen that no scheme has ever before been put forward which is so perfectly adapted to the use of twin screws. When it is desired, the stern of the ship can be carried further aft, to protect the screws; but this would probably be unnecessary. There is also ample room provided for engine power, notwithstanding the excessively fine run of the hull aft. The accompanying table contains the calculations on which the anticipated performance of the ship is based.

SYNOPSIS OF DESCRIPTION AND CALCULATIONS, RELATING TO AN OCEAN STEAMSHIP UPON NEW DESIGNS.

Extreme length	500	feet.
" breadth	74	"
" depth amidships from top of rail	45.5	"
Length on load water line	450	"
Breadth on load water line	56	"
" on upper deck (outside of frames)	68	"
Depth below load water line (draught of water)	24	"
Depth of extreme forward end (horizontal cutwater)	18	"
Depth of stern	18	"
Depth of lower part of the hull (midship section) from outside of bottom plating to top of main deck beam	22.5	"
Depth from skin to main deck beam	19.5	"
Height between the decks	9.33	"
Area of midship section below load water line (greatest immersed transverse area)	1,474	sq. ft.
Coefficient of greatest immersed transverse area	= 0.830	
Area of load water plane	= 18,154	sq. ft.
Co-efficient of loadwater plane	= 0.720	
Displacement to load water line	= 23,990	c. ft.
"	= 14,971	tons.
Coefficient of fineness of displacement	= 0.590	
Distance of center of buoyancy from stern	= 253.76	ft.
Depth of center below load water line	= 11.673	"
Height of metacenter above center of buoyancy	= 7.253	"
Height of metacenter above center of gravity of the ship when fully equipped and loaded	= 4.087	"
Wet surface when immersed to load water line	= 52,554	sq. ft.
Angle of obliquity at entrance and run	= 6° 40'	

The ship is to have two propellers of 20 feet diameter and 30 feet pitch. The propelling power to consist of four compound engines, two on each propeller shaft, developing each, when making 80 revolutions per minute, 5,700 indicated horse-power, or for all four engines together 23,800 indicated horse-power.

With this power the speed, according to Professor Rankine's formula, would be 20.2 knots per hour; but that speed would in all probability be exceeded, as little power will be lost by wave-making, the water having a clean run

astern, being divided horizontally by the lower part of the hull.

The ship would have room to accommodate about 600 first-class and 1,500 second and third class passengers, and carry 8,000 tons of cargo (or 4,000 tons if loaded to 26 feet draught of water), besides 3,200 tons of coal sufficient for 180 hours if steaming at full speed.

The great height of the metacenter above the center of gravity of the ship would safely permit yet another deck to be added, even with the unusual height of more than 9 feet between the decks, thus largely increasing the space and giving room for a much greater number of passengers.

The ship is designed to be built of iron or steel, with a double bottom up to the angle of greatest beam at 13 feet below the load water line, and with a great number of watertight compartments, transverse and longitudinal.

The weights of the parts making up the displacement and their distribution are as follows:

Weight of ship's hull	4,579	tons.
" on main deck (cabin fittings, passengers, etc.)	237	"
Weight on spar deck ditto	213	"
" on upper deck (deck houses, anchors, winches, boats, steering gear, etc.)	140	"
Weight of masts, spars, and sails	100	"
" water-tanks and water	190	"
" provisions and stores	100	"
" hemp and chain cables (besides those on upper deck)	21	"
Weight of engines and boilers, with water	3,150	"
" funnels and ventilators	40	"
" coals	3,200	"
" cargo	3,002	"
Total	14,971	tons.

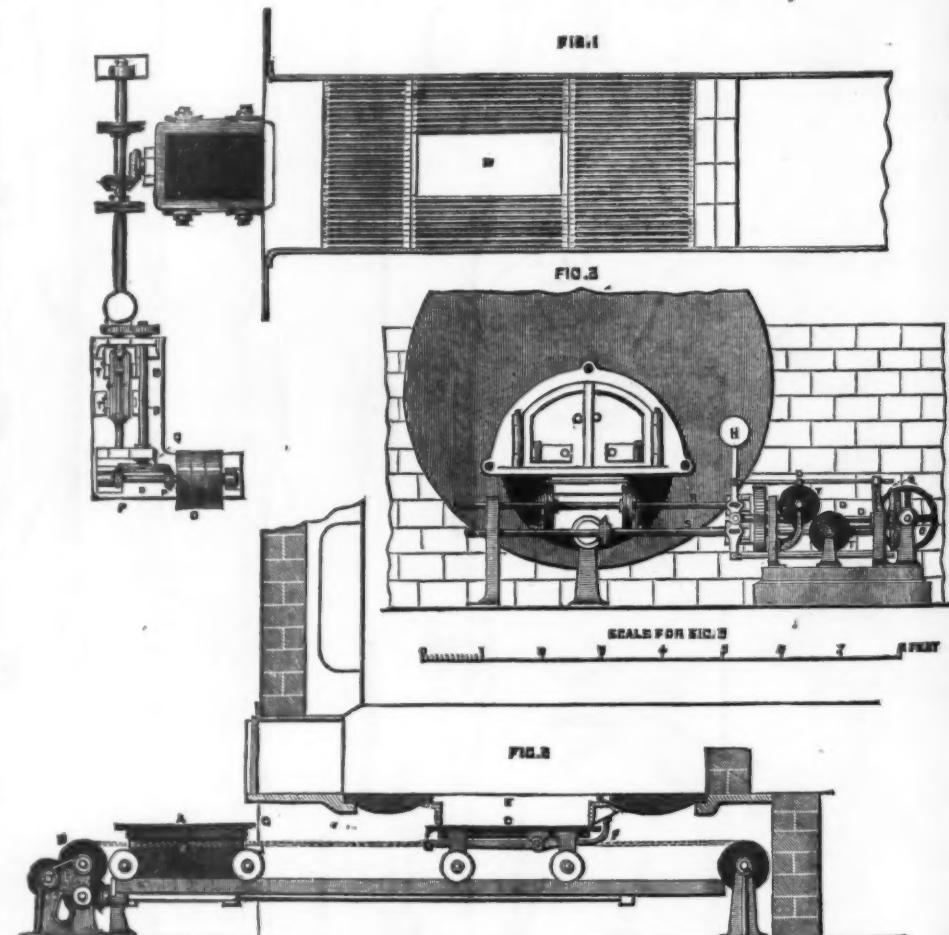
In calculating the center of gravity of the ship, due care

Lundborg's design, one which gives a ship with exceedingly fine lines and the smallest possible amount of what has been termed by Rankine "augmented surface," whenever the size of the ship is such that the draught can be about half the beam. Captain Lundborg's patents have only been completed within the last two months, but his designs have been very favorably received by several eminent authorities both in this country and the United States. Captain Lundborg's designs are not only the result of mathematical investigation, but of long and skillfully conducted experiments which gave without any exception results always in favor of Captain Lundborg's model. We trust that the merits of the design will soon be brought to a practical test by the construction of a steamer of moderate size. It is impossible to overrate the importance of the problem which we dare to think Captain Lundborg has gone some way toward solving.—The Engineer.

IMPROVED FUEL FEEDERS.

THE accompanying engraving illustrates a fuel feeder, by J. & W. McMillan, Port Dundas, Glasgow. These are made either to be worked by means of a crank by the stoker or by self-acting gear. About two years ago two of the former kind were fitted up at the Port Dundas Distillery, and shortly thereafter the manager certified that they saved 25 per cent. in fuel, giving greater and more uniform heat, consumed the smoke, was easily worked, and gave no trouble. The apparatus was subsequently fitted in Greenock and at Dublin.

The Messrs. McMillan are using the apparatus with self-acting gear, and it appears to give every satisfaction. They have it attached to one of the furnaces of a two-flued ordinary horizontal boiler of considerable size. The other furnace they prefer to leave in the meantime to be stoked in the usual way, so as to afford an opportunity to visitors to see by comparison the advantage of the feeder. But if the



IMPROVED FUEL FEEDERS.

has been observed not to get it too low down, so that the height of the metacenter above that point may be relied upon as being at least as much as stated. The stability is very great, increasing rapidly after the first few degrees of heel.

As a result of the calculations as stated above can easily be verified, we will only add the calculations as to the speed:

$$\text{Wet surface} = 52,554 \text{ sq. ft.} = 8 \\ \text{Mean angle of obliquity} = 6 \text{ deg. } 40 \text{ min.} = a$$

$$\text{Rankine's formula: } v = \sqrt{20,000 \times H.P.} \\ \text{Sin } 6 \text{ deg. } 40 \text{ min.} = 0.1161; \text{ sin}^2 a = 0.013479$$

$$4 \sin^2 a = 0.05991$$

$$\sin^4 a = 0.00018$$

$$1.00000$$

$$1.05400$$

$$\text{Augmented surface} = 52,554 \times 1.05400 = 55,396$$

$$v = \sqrt{\frac{20,000 \times 23,800}{55,396}} = \sqrt{8281} = 20.2$$

Hence the speed = 20.2 knots per hour.

The projection of the hull below water will go far to secure immunity from rolling, and presents no difficulties of construction which cannot easily be overcome, while it will tend to give a strong ship as well as one which will be fast.

In conclusion we may point out that we have in Captain

boilers were arranged in a line, one set of gear could be easily made to work a dozen at once, and each furnace could be supplied separately, if necessary, the gear being so arranged that either the whole or any part of it can be used. With their self-acting gear Messrs. McMillan state that they get a regular saving of 20 to 25 per cent., and there is no black smoke, except when the fires are being lighted in the morning. The coals being pressed up from beneath the furnace, the top of the fire is always clear, the combustion is thorough and regular, and altogether the apparatus promises well. It takes little power to work the apparatus. Messrs. McMillan work it now with belts and shafting from their large engine; but it may of course be adapted for a small separate engine to work it.

Should any accident take place to the gear, the furnaces can be fired in the usual way, as no alteration is made upon their doors. In the accompanying engraving, which is from *The Engineer*, the feeder is shown, in Figs. 1 and 3, fitted to a Cornish boiler, and in Fig. 2 to an externally fired boiler. In plan and side elevation the box, A, containing the green coil, is shown on the outside of boiler, ready to receive its charge, while the space provided, B, in the grate bars, is closed at the bottom by the plate, C, thus preventing the fuel from falling down. The gearing for moving the box and plate is shown in Fig. 1. Connected with the plate, C, is a lever, having a projecting catch, F, which enters into a slot, G, in the box, A. The working of the apparatus is as follows:

After the box, A, has received its charge, the apparatus is put in motion and the box is moved in under the bars, the catch, F, entering into slot, G, so that both the box and the plate go in until the box, A, comes exactly under the opening, B, in the grate bars, then the loose bottom of A is

FEBRUARY 11, 1882.

raised by the self-acting gearing, forcing the green coal up underneath and among the living fuel already in the furnace, after which the box is withdrawn, bringing the plate, C, with it until the lever touches a projection, thus relieving the catch, F, when the plate remains to support the coal in the furnace till box A returns and the operation is repeated. The remaining letters of reference indicate the same parts in the different views.

HIGH PRESSURE FILTERING PRESS.—SYSTEM OF BERTIN-GODOT.

In all the filtering presses which have usually been employed up to the present time for treating very diverse materials, the one defect recognized has always been the lack of a sufficient amount of pressure for a thorough purification of the material. The Bertin apparatus, shown in the accompanying cut, is claimed to overcome the defect noted and to possess other marked advantages.

It consists essentially of a horizontal hydraulic press whose head-block is traversed by a pipe provided with a valve-cock which is maneuvered by a hand-wheel. At one end this pipe, which is merely a continuation of the pipe which conducts the material to be filtered, projects outside of the press, and at the other, it debouches in the interior of the head-block between the two columns. The ram or piston of the press is arranged as in all hydraulic presses, and offers nothing peculiar. Between the head of the press and the piston are located the filtering disks. Each of these disks of cast iron has a male or projecting part and a corresponding female part. As each of these male parts is turned to the same diameter as the bore of the female part, it is readily seen that all the disks will fit into each other. Each disk is provided on each side with a projecting bearing which serves to support it on the two columns and to allow of its sliding backward and forward thereon. The vertical faces of the parts which fit into each other are provided with grooves cast in the iron, and which terminate in pipes beneath furnished with cocks for drawing off the filtered liquid. Upon these grooved faces there are placed disks of brass wire-cloth, and upon the latter is laid such filtering cloth as may be proper for treating the material to be operated on. The wire gauge and filtering cloth are both held in place by a circle fixed on the circumference of the face. The male part of each disk has, in addition, at its circumference, a rubber ring of special diameter designed to form an absolutely tight joint during the operation of the apparatus.

disks enter one another, and the material becomes pressed as if it were arranged in cakes under an ordinary hydraulic press. The advantages which this apparatus possesses are easily seen. In its operation there are two very distinct phases which correspond with two very different pressures. During the period of automatic charging, the material flowing into the press is exhausted, under the influence of the accumulator, at a pressure of say about 6 kilogrammes per square centimeter. Then, when the material parts with no more liquid, the hydraulic press is brought to bear on it, and with a pressure of 150 tons, the cake then undergoes a pressure of 50 kilogrammes to each square centimeter of surface. A 300 ton press would exert upon the same cake a pressure of 100 kilogrammes per square centimeter. Although our description of the operation is long, it need not be inferred that the operation itself takes long, for the contrary is the case. The press gives a large yield, and requires but two men to operate it. As soon as the extra pressure has been exerted sufficiently long, the two first hooks which connect the disks with the head are disengaged, and, the discharge being open in the hydraulic press, the counterpoise draws back the whole series of disks. These are then unhooked one after another, and the cake removed with a spatula. The clean disk is then pushed forward to its position for charging, and so on for all the rest.

Four operations per hour may easily be performed with each press, and a great deal of material may be treated; thus, for such materials as malt, paper-pulp, etc., we may estimate an average of 30 cubic meters per day.

The system of diffusion adopted in sugar-works gives this apparatus less interest as regards the treatment of beet-pulp; but experiments made with it, nevertheless, in such establishments have shown that by its use there is obtained a gain of 0.75 to 1 per cent. of sugar over ordinary hydraulic presses.

In conclusion, we may state that this high-pressure filter-press has given most excellent results, and its applicability to beet-pulp; to malt in breweries and distilleries; to paper-pulp; to the treatment of sewage matter, so as to obtain by cold process an odourless cake, permits us to rank it in the category of practical and useful apparatus.—*Annales Industrielles.*

QUARTZ CRUSHING MACHINERY.

At a recent evening meeting in San Francisco, Mr. John Richards, Superintendent of the San Francisco Tool Works,

by framing. Whatever power is put into a machine must pass out again less what is absorbed by friction. This is inevitable, and you will find in all machines driven by bands or otherwise, a force transmitted to the work, or in some other way absorbed, equal to what is communicated to or put into the machine.

The methods by which this force passes out of a machine, or is applied to work, determine the strains of machine action.

Take the case of a lathe for example. The driving power of the band passes off mainly at the point of cutting, communicating strains in various directions to the carriage, spindle, and framing. A rock-breaking machine is a still plainer example, because the expended force is nearly in one plane. The force of the band, moving 1,000 ft. in a minute, is communicated by reducing mechanism to the jaws, which may move two feet in the same time, the proportion being as 500 to 1. The strains in the two cases would be as the speed—that is, the pressure on the jaws would be 500 times as much as on the periphery of the driving pulley.

What I want to particularly point out now is that these

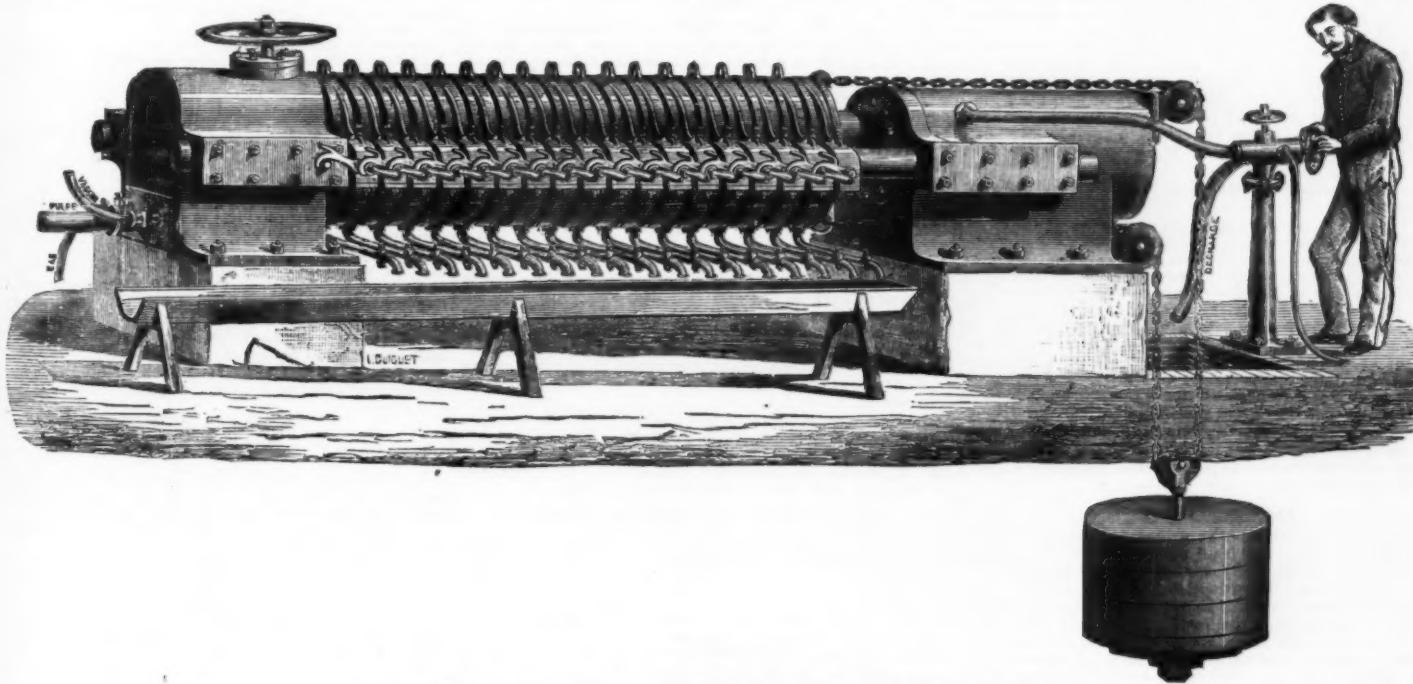
STRAINS WHEREVER THEY PASS OFF MUST BE RESISTED.

Action and reaction are equal. A force exerted in any direction generates an equal force in an opposite direction, so that in machine action wherever a force passes out of a machine there is an equal force passing back into the machine. Perhaps a simple lever will make this more plain. To use a lever we must have a fulcrum, or as we might say, two fulcrums. The force on the fulcrums and on the work are equal.

This law of machine action you can see proved in every example. Machines that exert great force, such as pinches, rollers, presses, and so on, have heavy, massive frames to resist reactive strains. There are, however,

TWO METHODS OF RESISTING THESE STRAINS.

You are all familiar with stamp mills and the method of their construction. They are a neat kind of machine, not capable of withstanding much strain in any direction. I doubt if the framing or other parts of a common quartz battery would stand a sufficient strain to crush a piece of quartz as large as an egg. A small piece of quartz would answer as a fulcrum for a lever that would pull the parts of a common stamp battery into pieces. Here then seems an anomaly! The best known and most effective quartz-crushing machine, surpassing all others in endurance, yet without



BERTIN'S HIGH PRESSURE FILTERING PRESS.

Finally, each disk has in its center an aperture whose diameter is equal to that of the pipe which traverses the head-block. The filtering surfaces are held in these parts by bronze rings.

If, now, we suppose all the disks fitted into each other, but leaving between the vertical faces of the male and female parts a certain amount of space fixed upon beforehand, we shall have as many empty spaces as disks; and, when such spaces receive the material to be filtered, the latter will be in contact on each side with filtering surfaces. To prevent the disks from getting out of place, while the press is being charged, each disk is provided with a movable hook which engages with the projecting axis of the hook of its neighbor. When all the disks are hooked together, then, the counterpoise fixed to the head of the hydraulic cylinder stretches them out to their normal extent and the press is ready to receive the material to be filtered.

The operation of the apparatus is, so to speak, entirely automatic. The material is first pumped into reservoirs, from whence it is sent to an accumulator whose pressure is regulated according to the material, its degree of thickness, etc. When the accumulator is full the pumps stop of themselves. If, at this instant, the cock in the head of the press be opened, the material will flow into the empty spaces between the disk, where, meeting the filtering surfaces, it will separate from its liquid, and the latter, being taken up by the pipes beneath the disks, will be led by them either into reservoirs or into the drain, according as the liquid is to be preserved or thrown away. The material is thus submitted to its preliminary pressure, that of the accumulator, and reaches a certain limited degree of dryness, but only about what may be gained in an ordinary filtering press. If, however, at this moment, the cock which allows the material to enter be closed, and the hydraulic press be caused to act on all those cakes which are now dried to a certain degree, such further pressure may be brought to bear on them (according to the power of the press) as may be desired. In measure as new quantities of liquid are expressed, the

delivered to the young mechanics and apprentices of the city lecture on "quartz crushing machinery," of which the following is a report:

The common processes for pulverizing quartz or mineral stone can be divided into four classes or divisions:

First—By *percussion* or blows, including stamps and all similar machinery operating by impact.

Second—By *pressure*, represented by machines having short range and positive movement—Cornish rollers, for example.

Third—*Maceration*, or rubbing action, represented by that class of machines where millers are employed.

Fourth—*Disintegration*, when the particles or pieces are reduced by attrition, or as we might say, worn away by striking against each other, or against parts of the machine.

The advantages of these different methods are to be judged from two standards—mechanical and economical—not that these two things are essentially different, for in the end they become the same thing, but because in the progress of invention and improvement the mechanical standard seems to be almost alone the only one considered.

In nearly if not all descriptions of quartz crushing machinery you will find explanations of mechanism—the manner of operating; but of the nature of the process, or its "genesis," as we might say, not one word.

Before proceeding to speak of these several processes, and apply to them the test of mechanical and economical principles, I will lay down, as well as I can, some of

THE MECHANICAL CONDITIONS

Under which all quartz or stone crushing machinery must operate.

These conditions, or principles as they may be called, are general, or universal we might say—not confined to quartz machinery alone, but applicable to all kinds of machinery.

The first of these conditions to which your attention had been called, is the strains of machine action, whether resisted by moving or fixed surfaces, absorbed by inertia, or resisted

strength enough in its framing or parts to crush a pebble of quartz! The force given out must fall equally in reaction on something, that is evident. If the stamp descended slowly and positively as the jaws of a rock-breaker do, we would soon see where this reaction force was expended. One stroke would be enough to lift the framing from the battery.

THE FORCE EXPENDED ON THE QUARTZ

Is absorbed by the inertia of the stamp head, stem, and die. The force of the driving band is communicated by the cam and tappets to the stamp and stem, raising it by a force acting throughout only one-half the time. This accumulated force is expended on the quartz in perhaps one-hundredth part of the time, and with an intensity, or measure, corresponding to these relative times of action. The reactive strains of the blows are not communicated to the framing of the machine, only concession or jar. The driving force that does fall on the framing is communicated from the bearings of the cam shaft. This strain is slow and easily resisted.

This matter of inherent strain in machines and the framing we find resolved into a proposition like this: In all machines acting by impact or blows, the force expended on the work does not react on the framing, but is absorbed by the momentum and inertia of moving parts. Second—That all machines with positive or direct action have to resist in their parts a reactive strain equal to that expended on the work. Here you will perceive a broad distinction between stamps and all machinery having positive movement, rollers or millers for example. The value of this distinction we will consider further on.

THE SECOND CONDITION OF MACHINE ACTION

I will call your attention to is the maintenance of cutting or abrading edges and surfaces, the point where power is given off, so to speak.

In machines for cutting metal their action is expended at

the cutting edges of the tools, and the maintenance of these edges is the most expensive part, except attendance. It includes tools, tool dressing, and grinding. In wood cutting the maintenance of edges is also an important part. Whenever a machine deals with material, whether by cutting, crushing, rubbing, or otherwise, there is a constant destruction of the implement, be what it is, that stands between the machine and the material acted upon.

In a stamp mill these implements are the shoes and dies. In other quartz crushing machinery they are represented by the surfaces that come in contact with the material. The abrasive wear of metallic surfaces in quartz crushing is a matter you are all familiar with. In any particular method of pulverizing quartz, there is

WORN AWAY BY ABRASION

An amount of iron or steel corresponding with the quantity of stone crushed; the same as there is a nearly regular amount of edge worn away in cutting iron or wood, only much more. This wear is one of the principal items of expense in maintaining quartz crushing machinery; and I incline to the opinion that the wear of such surfaces is in proportion to their rubbing action mainly; that is, the wear of the abrading or acting surfaces is least when they act parallel to each other. I am also of the opinion that the wear of such surfaces, shoes, dies, or the jaws of a breaking machine, for example, is not in proportion to the hardness of the material employed, but as its friability. Every mechanic is aware that a hard file can be rapidly ground away on an emery wheel, while a piece of soft iron can not. The surface of Cornish rollers, I am informed, wear longest when of wrought iron, and I think in respect to shoes and dies a close hard, but at the same time malleable material will last longer than a hard one, or one that is friable.

What I want to point out in this connection, is that in

STAMPS OR PERCUSIVE MACHINERY

For ore crushing the wearing surfaces are provided from cheap material, and require but little fitting to prepare them for use. Shoes and dies for stamp mills, with the required preparation, are worth only a few cents a pound at this time, while for any machinery operating by positive motion, rollers, mullers, and so on, the wearing surfaces would cost much more for renewal. At the late exhibition here there was, for example, a machine where the abrasive or crushing surfaces were of tempered steel or chilled iron—I do not know which; but at any rate would require turning, and would cost perhaps three times as much relatively as shoes and dies for a stamp mill. Not only this, such rollers, if of hard material, would without doubt wear away much faster than is made of some close malleable material.

In a common stamp battery the crushing faces, so to call them, approach each other parallel; and, aside from the slight rotation given by the cams, there is no rubbing action. Such rubbing action is required in that case to cause a uniform wear upon the die faces, and is perhaps just enough for that purpose; so that in respect to use as well as first cost, we find the percussion or impact principle the most favorable in an economic way.

The third condition of operating, to which I will call your attention, is

MAINTENANCE OR WEAR.

Including the regular depreciation and accidental breaking of parts. At first thought it would seem that machinery acting by impact or blows would be more liable to accident than that which operates by pressure or rubbing. This would be true of percussive machinery that expends its force on metal, as in the case of steam hammers; but it is not true of ore-crushing machinery, where the dies drop on a layer of quartz and pulp that cushion them.

If a battery was so perfectly made that the dies and shoes would fit on their faces, and such a battery was run without anything in it, then the analogy to metal hammers would hold good—the results too, perhaps; for I imagine the heads would split, the tappets move, and the machine become a wreck in a short time.

WEAR IN STAMP MILLS.

Compared with other ore-crushing machinery, the percussive class is more free from wear and accident. Taking a stamp mill for example, there is no strain to speak of on any moving joint. The principal stress is of course on the cam-shaft bearings, but that is not great, and, as experience proves, these bearings are easily maintained. The other joints, we may call them, where wear can take place, are the stem bearings, and the contact surfaces of cams and tappets. Both these joints or bearings, as well as those of the cam-shaft, are placed far above the stamps where the surfaces can be protected from sand and grit, where they can be oiled or examined without trouble and renewed without much expense.

If you will now consider any

MACHINE OPERATING BY PRESSURE,

Maceration, or disintegration, you will in most cases find bearing surfaces that have to withstand a pressure equal to that applied to the quartz. I know that in some machines this pressure is balanced by a double action; that is, one surface acting against another, as in the Redstone machines; but in the case of rollers, and indeed in nearly every machine, the stamp mill excepted, you will find bearings in the vicinity of the quartz that have to resist great pressure, and which must be kept close. Such bearings must soon be destroyed, and it requires no wide experience to determine the wearing life of such machinery without seeing it at work.

In all machinery acting positively with great pressure and on hard substances, the breakage, as we call it, is an important item in maintenance. In this class belong rolling mills, bolt and rivet machines, presses, pinches, and most kinds of quartz machinery, not included in the impact class.

FACTS OF EXPERIENCE.

I will digress here to remark that no doubt most present have thought that the best method of determining these various conditions of machine action would be to observe and collate facts. This seems a most thorough way to reach true conclusions, but is unfortunately impracticable, and if practicable, could not be applied to hundreds, perhaps thousands, of quartz-crushing machines yet to be invented. The facts of past experience, even if they could be collected and compiled, could only be applied to new inventions by analogy, and to be able to draw such analogy, the present method of investigation is necessary.

In a former lecture I had the honor to deliver here, your attention was called to the value of analytical reasoning, respecting mechanical problems. It is especially important in our present subject, because the process is not a common one, and but little is to be drawn from popular conclusions.

Returning now to the

COST OF MAINTENANCE.

There is one factor in such cost that I may not be able to make so plain as the wear of dies. I mean the interdependence of parts one upon another. This is an element of much importance in many kinds of machinery, as well as that for ore crushing.

Suppose, for example, that a quartz mill of ten stamps will crush ten tons of ore in a day, and that one of the steam stamps, such as are made in England, will do the same work, the cost of the machinery and running expense would perhaps be much the same, but there would be this difference. The steam stamp would depend upon each part; a single screw broken would stop the machine; to put in a new die would stop all; the product, too, would have to be the same in order to get a good result from the power expended. Such a machine, if kept operating three-fourths of the time, would do well.

The common stamp mill, on the contrary, would in most respects represent ten machines, each one almost independent of the rest. It is true the parts would be more in number, but the chances of delay from accident would not be nearly so great as in the case of a single stamp of ten times the capacity. One battery could be stopped; the others would go on just the same; or any one of the ten stamps could be "stopped up" in an instant, and the rest go on.

I could go on with various other conditions of operating, such as feeding and clearing batteries, the uniform resistance to motive power, and so on, but time will not permit. I had also, at the beginning, intended to carry our investigation to machinery acting by pressure, maceration, and disintegration, but the rest of the time can, I think, be better spent in some general remarks. What I have thus far said has been mainly to call attention to a method of investigation. The value of this method you can yourselves determine by applying it to the history of ore-crushing machinery in this and other countries.

For centuries past,

THE STAMP MILL.

Or other machinery with percussive action, has held its place as the best and most economical. Mineral stone, or quartz at least, is a hard material of crystalline structure. Stone that has been melted, and is homogeneous, a blow rapidly given will cause more fracture than the same force applied as pressure or in rubbing. The first ore reduced was, no doubt, pounded fine with hammers, so was the last crushed to-day, and so will the process be carried on in the future.

There have been in California many inventions in ore crushing; most of them relating to stamps have been of value, and mark an advance, but there have also been many inventions, some of them costing large sums of money, that were founded on principles at variance with the operating conditions pointed out this evening. The premises have been wrong; the starting point, instead of being an effort to supply some wanting element in the process, has generally been some new mechanism that supposedly would give results better than a stamp battery.

I venture the opinion that in a process so simple and backed up by a long train of experience,

THERE SHOULD BE NO MISTAKES

Made as to the value of new ore crushing machines, not in so far as pulverizing at least.

I do not, however, claim that the several propositions laid down this evening cover the whole ground—far from it. Yet the methods pointed out, if fully and completely applied, will, I believe, determine the true merits of new inventions without the expense and labor of constructing machines for experiment.

A little more than a year ago I was consulted as to a proposed new method of crushing quartz. The subject was new to me, and, I may add, fortunately so, because I began at the beginning and proceeded inductively, so to speak, but for all that, came near running into a great error.

THE PROPOSITION WAS TO EMPLOY ROLLERS.

Not the common Cornish arrangement, but one more elaborate and involving details which need not be described now. As is always my custom in such matters, the first thing was to examine the history of the art, and observe its tendencies. I found in California that reciprocating breakers were employed instead of rollers. I knew also that since the introduction of these machines in Europe the rollers had given away to them. Stone crushing at the mines and for streets was done by reciprocating machines—yet it was difficult to see why a large roller revolving continuously would not far exceed the performance of a reciprocating machine with one-tenth of the surface and still less speed. The problem was a quandary in my mind for a month, when it was cleared up in a few minutes by a proposition mentioned, I think, previously this evening, namely, the capacity of a machine for crushing is as the parallel approach of the acting surfaces or their angular velocity. I had been counting the circumferential velocity of rollers, not the angular velocity of their periphery, and to my astonishment, I found the rock-breaker outran the revolving roller.

Measured by this standard all became plain, the supersession of Cornish rollers was no longer a mystery but a natural sequence of improved machinery and method. [Illustrated on the blackboard.] This I relate to show how certainly one can reach correct conclusions without experiment if the true premises are gained and deductions made accordingly.

The methods I have described are those of the consulting engineers, a profession almost unknown in our country.

INVESTMENTS ARE MADE HERE IN NEW INVENTIONS AND SCHEMES

Without such precautions as are employed in older countries. In matters of law, or indeed in nearly all cases except engineering or manufactures, the counsel of skilled persons is called in, but in new mechanical expedients, the Keely motor for example, the shareholders do not think it worth while to consult a scientific man or competent engineer. Suppose two men were to start out to-morrow to search for capital to be employed in two undertakings; one to develop some new motive power on principles that controvert all the established laws of dynamic science; the other to establish the manufacture of horse shoes and hoofs, which do you think would succeed best? The tendency is to the marvelous; the popular conception of invention is that it is chance and accident. Let me assure you this is not so, and that inventions and true progress can become a matter of principles and demonstrative science. Since I have lived in San Francisco I have seen thousands of dollars expended on

machinery that controvert several of the very plain operative conditions before named. Every one, almost, thinks himself competent to pass opinions upon quartz crushing machinery, mechanics and miners perhaps least of all.

In all such cases where one meets an inventor of quartz crushing machinery, the first question should be what particular part of the present method is at fault, and how your machine to remedy this? Second, is it certain the new machine embodies all the functions and advantages of those now in use? There has been

AN AGE OF CHANCE

In these things—a time when a tailor, a shoemaker, or politician might invent mechanical processes and machines, but that time is almost gone. It was the dark age, so to speak, of invention and of dynamic science. A little of this kind of invention remains—discovery we should call it. In chemistry, for example, and in electricity and magnetism, where intangible gases are dealt with. I firmly believe in respect to ore crushing machinery that there is in this city enough and more than enough knowledge of the process to enable a complete judgment to be formed of any new machinery for the purpose without experiment.

I know, too, that there are not many who will concede this, and that it is almost a heresy to make such a proposition, but I ask especially of the younger mechanics here to-night, to remember this and see if the future will not prove the assumption.

For thirty years it has been my fortune to be in some way identified with the construction of machinery, the most of it novel, or at least varying from the beaten path; and every year as experience goes on the more I see proves that in the future, and not distant, nearly all processes in converting common materials such as wood, stone, metals, and so on, will be determined with experiment.

As remarked in a previous lecture, I ventured such an opinion ten years ago respecting metal, working tools, that is tools for cold processes, such as turning, planing, drilling, milling, and so on. The idea met with some criticism, not to say derision, especially among the chance schemers, but it has been steadily gaining ground, especially in continental Europe, and more especially in Germany, where the science, so to call it, of mechanical analysis has a fast hold. In our own country the great advances made in mechanical art has been mainly

DUE TO QUICK PERCEPTION,

Rather than methodical deduction. The experimental method is safest and surest up to a certain point, when the margin of improvement becomes narrow, then the inductive method must prevail.

We are tending that way, but not so fast as we might. With fifty millions of population we have fewer technological schools than Sweden with a population of four millions. Northern European countries, including even Russia, which the English tell us is uncivilized, are in advance of this country and England in the matter of technological schools.

The effect of their system is being felt all over the world, and we cannot much longer ignore its importance. Our wonderful skill in making things is more than balanced by our competitors' understanding them better. They will learn to make our products in time, and unless we employ their means may excel us.

To illustrate this let me ask how long the Keely motor humbug would have lasted in Northern Europe, Germany, or Sweden, for example. I do not think this shameful humbug could have existed there eight weeks, much less eight years. We have here all the elements of a rapid and wonderful progress in mechanical art, except the analytical methods of investigation, and if I have succeeded in causing some interest in its application to ore-crushing the object of this evening's lecture has been attained.—*Mining and Scientific Press.*

GOLD MINING.

THIS following report by Mr. Thomas Price to the Chairman of the Placerville Gold Quartz Company, Limited, dated San Francisco, April 16, 1881, refer, in part, to Mr. A. G. Lock's paper on "Modern Gold Mining," read before the Society, January 19, 1881:

"In answer to your favor of the 8th ult., on the subject of gold amalgamation as carried on at the Placerville Mill, I take very great pleasure in replying in detail.

"1st.—Description of mill: The mill has twenty stamps, each stamp being of an average weight of 800 lb. Each battery of five stamps is furnished with a self-feeder. The self-feeders are connected with a large bin, having a capacity of three hundred tons of quartz; the floor of this bin is placed at an angle of fifty degrees, so that the quartz slides by gravity to the self-feeders. The quartz is delivered from the mine by a self-acting tramway to this bin, the fine material passing through a grating, the coarser lumps remaining on the floor of the rock-breaker, both the fine and crushed material falling by gravity into the fore-mentioned bin, so that the ore passes from the mouth of the shaft into the battery, without the aid of any manual labor, with the exception of the labor in placing the large pieces of quartz into the rock-breaker.

"The mortar has but one discharge, and that in front; the screens are made of thin slotted Russian iron, equal to 450 holes to the square inch; inside of each battery in front is a slip of silvered copper plate, 8 inches in width by the total length of the battery. Immediately in front of the battery again is a large silver-plated copper-plate, equal to the total width of the mortar by 3 feet in length, in front of which is placed again a 20 foot 18 inch sluice, the bottom of which is lined with silver plated copper-plate, constantly kept in a bright condition. The tailings are now passed over what are known as Hendy's concentrators (there being one for each five stamp battery).

"The tailings are now again passed over 20 foot blanket sluices, and afterwards on 50 feet of coarse canvas sluices, or rather sluices lined with such material, and finally over 64 feet of riffle sluices. The material caught on the concentrators and blankets is passed through an amalgamating pan, and settler, and agitator.

"The accompanying printed description will explain this part of the operation. The material saved on the coarse canvas and riffle sluices is further concentrated in a Cornish bubble, as are also all the tailings from the amalgamating pan and settler. The quantity of quicksilver placed in the mortars or coffers is regulated by the appearance of the copper-plate in front of the battery; the quicksilver is fed at intervals of half an hour. The blankets are washed every hour; the coarse canvas every three hours.

"The tailings are regularly and carefully sampled; the same have been assayed by me with results varying from mere traces to 75 cents per ton; in one instance only

FEBRUARY 11, 1882.

did they ever reach as high as \$1.50 per ton. We endeavor to arrange, as near as we possibly can, a speed of some 75 drops to the stamps per minute. Of course this could be largely increased, and consequent increase of crushing; but this would be at the expense of losing a much higher percentage of gold. We have never had any trouble with the flouring of the mercury.

"2d.—I will now make what comments I deem necessary on Mr. Lock's paper, read before the Society of Arts. I had read this paper before, as I am a subscriber to the *Journal* of this Society for many years. (1st.) In the matter of 'gauge of gratings or screens.' The size of the screens should depend entirely upon the fineness of the gold in the quartz. If the gold should be diffused in a finely divided state through the quartz, it is evident that finer crushing must be had than if the gold were coarse. I have given the size of the perforations of our screens. (2d.) All the protection to the mortar by having the dies rest upon a layer of sand has always been in use. We have not had any broken mortar as yet. The stamp-heads and the dies upon which they strike are of the same size; this we consider a protection to the mortar and stamp-head, that is, the layer of sand under the dies. With such fine gold as we have to deal with at the Placerville, we could not expect much fine gold caught in this material. We rely upon our amalgamated copper-plates inside of the battery for this purpose, and I have no hesitation in stating that this is by far the best way to catch the maximum amount of gold. In the early days of gold mining in California, the stamps were used slightly for the crushing of the ore, the amalgamation was conducted on the outside entirely, the only gold caught in the battery being coarse particles that could not pass through the screens. Experience has taught the mill men here that this latter method is not only more expensive, but by far less effective. I cannot agree with Mr. Lock when he states, 'I venture to assert that this system of putting mercury into the stamp coopers and using amalgamating plates, is radically wrong.' The difficulties that he speaks of, viz., the loss of quicksilver flouring, does not trouble us. I also claim that the particles of amalgam passing through the screens are caught either on the copper-plates in front, or on the Hendy concentrator, and if any escapes here, why we have the blankets, coarse canvas, and rifle sluices, and finally the Cornish buddles.

"The last few weeks I have had some experience with the system designated as 'mercury rifles' and mercury troughs, as fully described in Mr. Lock's paper. I had to examine a mine where they were in use, having been put in and erected by an experienced Australian mill man. I found the tailings containing an abnormal quantity of gold. The owners found it necessary to change this system to amalgamation on copper plates inside the battery, with the usual outside appendages, already described. (3d.) The statement that the gold is flattened out by pulverization in the battery is not a fact, as the gold is really brittle, and is rather pulverized into small irregular particles than beaten or hammered out into thin plates. (4.) The flouring of the mercury is not caused by the presence of sulphide of iron, so far as my experience goes, but such is the case when sulphides of copper and lead are present in any considerable quantity. In all of our clean-ups at the Placerville Mill, we have never had any trouble with the 'flouring' or the 'sickening' of the quicksilver. The system of concentrating on blankets, as done in some places, collects not only the gold, but much of the metallic iron produced by the wear and tear of the shoes and dies. (5.) The only way to ascertain the true value of auriferous quartz, assaying only from $\frac{1}{4}$ or 1 ounce of gold per ton, when dealing with hundreds of tons per month, is by a careful system of sampling the tailings. The total clean-up, plus amount in tailings, represent the total amount per ton. We sample our tailings at Placerville by taking a bucketful of tailings at regular intervals of two hours, water and all, from the final tailings through a large filter; at the end of each week the accumulated samples are averaged, and at the end of the month the weekly samples are again mixed, and an average sample taken, which I assay.

"Now, as to the facts connected with the value of tailings from quartz mills in California. During the last eighteen years I have been in this country I have had occasion to examine a very large number of gold quartz mines. At a very large number of these mines large piles of tailings had accumulated; many of these piles I have had occasion to sample, as they were represented to be very rich, but, as a rule, I did not find them sufficiently rich to pay for the handling. It is a very popular thing for a superintendent to say your mine is good, plenty of gold in the quartz, but it is so rebellious that it is impossible to save the gold. Many such a mine have I had occasion to examine, and, to the sorrow of the stockholders, found out that the rebellious character was due entirely to the fact that the quartz contained but little gold. I have no hesitation in stating that, with proper care and attention, the system I have described as in your mill at Placerville is more effective for the quartz we have to deal with than the one described by Mr. Lock. What gold we cannot save on the mortar plates, copper-plates in front, Hendy's concentrator, and the blankets and canvas, the rifle boxes and Cornish buddles will catch. I have endeavored to cover the whole subject, and if I have not, please let me know, and I will give you any additional information I may have. I will give you further guidance as soon as I have time to send you sketches of all parts of the mill, explaining all in detail."

This report has been communicated to Mr. Lock, who has sent the following remarks upon it:

The above report, by Mr. Thomas Price, is the result of, and in answer to, a list of questions which I have addressed to all the gold mining companies, for the purposes of my forthcoming book on "Gold; its Occurrence and Extraction."

I am pleased to be able to take this opportunity, publicly, to thank Mr. Price for his kindness in so fully answering my questions, and I earnestly hope that his good example will be followed by all who have received a similar list.

With regard to his comments on my paper read before the Society of Arts on the 19th of January last, I do not think the pages of the Society's *Journal* the proper place for a lengthy discussion; I must, therefore, refer him, and all others interested in the topic, to my book, where the different systems adopted by each country will be compared and fully discussed. But I cannot help, meantime, remarking that Mr. Price's experience in the matter of loss of gold is strangely at variance with the statements of the highest authorities, a few of whom I will quote.

Professor R. W. Raymond says, in his report to the United States Government, in 1875, that, "with a few exceptions, from one-third to one-fourth of the assay value of the ores now being worked, amounting to several millions of dollars annually, is irretrievably lost."

Mr. Walter A. Skidmore gives, as will be seen in the table

below, the loss of gold at Colorado at 40, and in California at 27 per cent.

Mr. Almarin B. Paul says that the loss in America "is fully 30 per cent., and in the majority of all mills 60 per cent. of what the ore contains."

Mr. George J. Firmin states that in the Black Hills, Dakota, "they only obtain from 10 to 15 per cent. of the gold," and that the general result of his inquiries throughout the country is, "that not more than 50 per cent. of the assay value is recovered on the average."

Nor are the United States singular in showing such a waste of gold.

Mr. Edwin Gilpin, A.M., F.G.S., the Inspector of Mines for Nova Scotia, reports that since returns have been collected, which enable him to ascertain results, 19,000 tons of pyrites, containing on an average 2 oz. 4 dwt. of gold, and 4 oz. 17 dwt. silver, with a value of £10 10s. per ton, have been thrown away; in other words, over a million of dollars has been thrown into brooks and swamps during the last eighteen years." In a letter to me in March last, he characterizes this loss as due to the fact of "the chief idea being to pass as much as possible through the mill, and turn the tailings into the nearest brook."

Mr. Walter A. Skidmore's "table of the losses sustained in gold-mining countries" referred to above, gives—

	Per Cent.
Piedmont.....	.35
Hungary.....	.50
Chili.....	.66
Australia.....	.25
Colorado.....	.40
California.....	.27

I have now lying before me a letter written in February last, by Mr. F. Guinness, warden and resident magistrate of the Collingwood goldfields, Nelson, New Zealand, in which he speaks of the melancholy fact that, through the inadequacy of the appliances and the want of knowledge how to extract the gold, the district, after repeated trials, has been deserted, and gold-mining abandoned. "little or no gold being obtained, yet the analyses of the quartz gave results of most hopeful returns, as much as $4\frac{1}{2}$ ounces of gold to the ton having been obtained from stone which Dr. Hector and myself took out of the reef."

But to conclude, it appears to be owing to the nature of the ore with which Mr. Price has to deal, rather than to the efficacy of the appliances employed, that he has so little loss, for we find that the Idaho Company, Grass Valley, California, whose appliances are of the most elaborate character, extending the great length of 270 feet from the center of the stamp heads, lose about 27 per cent. of their gold, obtaining 47,900 dollars, and losing in their tailings 18,67 dollars per ton of ore.—Alfred G. Lock, F.R.G.S., in *Journal of the Society of Arts*.

ELECTRIC EXPLODING APPARATUS FOR MINING PURPOSES.

THE EXHIBITION OF Electricity has shown us a pretty complete collection of mine-exploding apparatus, either charged with powder or with new explosive substances, such as dynamite, gun cotton, or dynamite gum, designed for opening subterranean galleries in tunneling and in mineral exploitations, and for use in the military art. The French Minister of War exhibited, in addition to the Brequet machine, usually known as the *Coup de Poing*, a series of electric percussion primings, specimens of primed dynamite cartridges, and, as a sort of historical document, the first submarine torpedo employed in the Chinese seas. Private industries likewise set several models of machines, such as those of Mr. Bürgin (Swiss section); those of Mr. Mowbray (American section), employed during the driving of the great Hoosac Tunnel in Massachusetts; and those of Mr. Bornhardt (French section). The Minister of Public Works of the German Empire and the Austrian Minister of War exhibited a remarkable series of portable exploding apparatus, along with pamphlets or vade-mecums for the instruction of the electrician.

We shall confine ourselves on the present occasion more especially to matters pertaining to the management of such apparatus as are used in connection with new explosives in public works and in the industries; while we shall reserve

specimens of steel ruptured by the explosion, form the interesting part of the exhibition.

The machine exhibited by the Dynamite Society is specially employed in Austria and Germany. Its details may be studied in the accompanying Fig. 1. Two ebonite plates, B B, are caused to rapidly rotate through the medium of a winch maneuvered by hand. The electricity with which they become charged is collected by the combs, d d, which are protected by an ebonite insulating disk and put in communication with the armatures of two Leyden jars. An independent screen, e e, likewise of ebonite, is placed in front of the external armatures of the jars and between three armatures and the disks, B B, for the purpose of preventing a loss of the fluid. The conducting wires are fixed to the metal rings, a and b, which correspond to the two armatures of the Leyden jar; and the two rings are connected with the rod, g g, whose extremities alone are of metal—the intervening portion being ebonite. This rod,

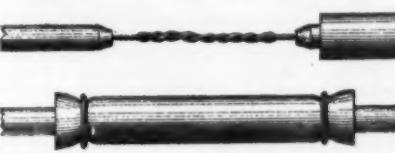


FIG. 2.—METHOD OF SPLICING AND COVERING THE CONDUCTING WIRE.

is capable of oscillating around the metallic axis, g, which is connected both with the external armature of the jar and the fixed return wire at b. Through the action of a button, m, the head, A, of the rod leaves the ring, a, against which it was pressed by a spiral spring, and which it carries along with it as it goes to rest against the inner armature of the jar at b'. The fluid is led to the primers by the wire, a, and from thence to the return wire. The losses of electricity is prevented by an ebonite insulating disk, p p.

The apparatus is inclosed in a rectangular wooden case of convenient size (22 by 14 by 11 inches), which is divided into two compartments by the partition, M N. The back compartment, containing the Leyden jars and the disks which generate the electricity, is always closed; but the one in front, which contains the external armatures, a and b, and the button, m, is provided with a cover. This latter compartment contains also the winch, which is thus protected against being handled by curious persons who might bring about an explosion and consequently an irremediable disaster. Certain accessory arrangements, such as stuffing-boxes for the winch and a lining of thin sheet iron for the inner sides of the case, insure of the apparatus working well and of its being protected against dampness, and consequently



FIG. 3.—SECTION OF PERCUSSION CAP.

from all losses of electricity. It is well, before putting the apparatus in operation, to thoroughly dry the ebonite disk of the front compartment, as well as the two external armatures.

The operation of the apparatus, then, is extremely simple—twelve turns of the winch and a pressure on the button, m, being sufficient to cause a simultaneous explosion of all the primed cartridges in the mine. Sometimes, however, either by reason of dampness or some internal disarrangement, it may be necessary to turn the winch twenty times. After such a number of revolutions, if there is no explosion, the apparatus should be set aside. In order that the experimenter may not be exposed to the annoyance of miscalculation (the minutiae of arranging for a blast taking some time), the inventor of the apparatus that we have just described has placed in the front compartment a very ingenious experimental device which allows of discovering whether the apparatus is in proper working order before the conductors are definitely attached to the armatures. A row of ten copper furniture-tacks is fixed along the inner surface of the front end of the case, and to each of the tacks at the extreme ends of the row there is attached a small copper chain which may be hooked to the armatures,

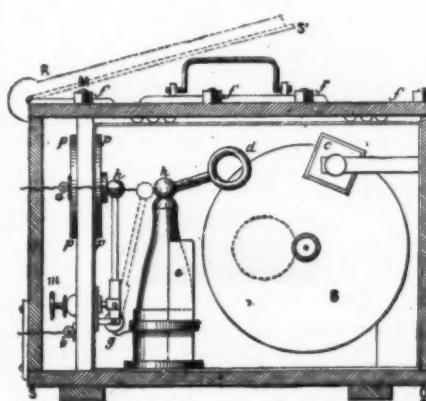


FIG. 1.—ELECTRICAL EXPLODING MACHINE FOR MINING.

for another occasion the study of firing from a distance engines of war—and especially torpedoes. The use of electricity as an agent for blasting in mines, and as a general thing, in all explosions necessitating several simultaneous charges, tends to become more and more extended; and it is under cover of this fact that the Nobel Dynamite Society has placed at the Palais de l'Industrie a special exhibit in which the machine itself is seen side by side with the powerful agent without which it cannot operate, and that is, dynamite, or rather explosive gum, an intimate mixture of nitroglycerine and gun cotton, which has recently been introduced into the industries. It seems useless to describe in detail the Dynamite Society's very simple arrangement of apparatus as displayed in their exhibit. A series of percussion caps, disposed with art according to the exigencies of the limited space accorded to the exhibitors, is connected by means of conducting wires with an electric machine of the Bornhardt type, which, with the

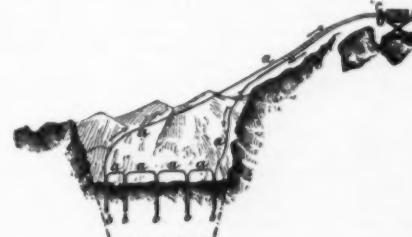


FIG. 4.—ARRANGEMENT OF THE APPARATUS FOR BLASTING IN A SHAFT.

a and b. If, then, we attach these chains, turn the winch, and press at the tenth revolution on the button, m, a series of sparks should occur between the copper tacks, thus making us certain that the apparatus is in good order, and that, consequently, the conducting wires may be definitely attached to the armatures of the machine.

A few words only as to the conducting wires themselves and their arrangement in the place where blasting is to be performed, and as to the percussion-cap, and we shall have finished our description of the method of causing explosions by means of one of the apparatus for the purpose exhibited at the Palais de l'Industrie. The metallic conductors are of brass, and their diameter ranges from one-half to one millimeter. In dry localities the wire employed may be naked, although as a general thing the conductors used are the gutta percha coated ones that are now so common and so cheap. If the operation is to be performed under water or in a damp locality, the mode of joining the wires at dis-

connected points or with the wires of the percussion-cap is quite simple. In Fig. 2 may be seen two brass wires that have, after the removal of the gutta percha coating, been spliced together, and the section afterward covered with India-rubber. This mode of covering with rubber tubing can only be applied where the wires are quite thick; with wires of half a millimeter and thereabouts it simply suffices to take sheet gutta percha and apply it to the joint by means of the heat of the hand.

Along with the exploding machine and the conducting wire, the percussion-cap forms the entire arrangement for blasting by electricity. As we have before said, the Austrian Minister of War exhibits a remarkable series of these primers, in which we may follow all the phases of their manufacture and their internal arrangement. A given charge, k , of fulminate of mercury is inclosed in a copper cylinder (Fig. 3). The explosion of this charge is produced by that of the part, $m m$, which contains an explosive material that is inflamed by an electric spark passing between the two metallic wires to which the conductors are fastened. These two copper wires are placed only a quarter of a millimeter apart, and the whole cap is protected by an insulating coating of pitch.

But a slight notion of electricity is required to allow it to be understood how the charges themselves are arranged for the blasting of several drill-holes in a tunnel or quarry, as shown in Fig. 4. Here A is the electric machine; C and D are the conductors; and b , b , b are the primers, connected by the wires, a , a , a . This was the arrangement adopted by the Dynamite Society for exploding the block of steel shown in Fig. 5. If we refer to the inscription accompanying this specimen, we find that the entire charge necessary to shatter it was 8 kilograms, divided into twenty charges of 400 grammes each. This is a very interesting result, although one very easily reached by the methods we have just pointed out. We find herein a new proof of the marvelous power of dynamite; but we should have preferred, however, that the Dynamite Society had placed before the eyes of the public the economic results that have been reached in subterranean operations by the combined use of new explosives and electricity. Such results, according to our own knowledge, may be obtained at one-fifth the labor expended in the ordinary modes of blasting.

In order to give an idea of the mining explosive apparatus exhibited at the Palais de l'Industrie, if we have selected the Bornhardt machine, it is because a description of this adapts itself very readily to the details that we propose to give regarding the method itself of blasting. Moreover, we state frankly that in the practical experiments that we our-

be proportional to the potential and not to the elementary density of the electricity. A direct application of the law of Faraday leads, then, to the law just pointed out.

[Continued from SCIENTIFIC AMERICAN SUPPLEMENT, No. 315, page 505.]

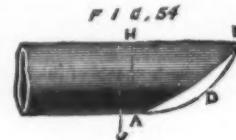
PRACTICAL NOTES OF PLUMBING.*

By P. J. DAVIES, H.M.A.S.P., etc.

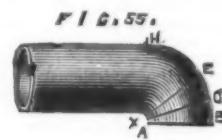
KNUCKLE BENDS (Figs. 54 and 55).

THESE bends are not unfrequently used in small-pipe work, especially for the bosses of cocks, valves, etc. They are likewise very handy for rain-water pipes, when the pipe is required to convey water from a cesspool through a wall into a rain-water or cistern-head, as also for trapless and some other water-closet work, such as Jennings' closet and trap in one piece. They are made as follows:

Fig. 54 shows the method. Most plumbers cut the end as



from A to B, others cut it as shown by the dotted lines, A, D, B, and then work the end, B, over, as best they can (often taking double the time they ought in doing it). The proper way is first to strike the outline of the bend on the bench or floor, as at Fig. 55. X is the point to first strike the



throat, A, from; then open your compasses to whatever size your bend may be required, and from H strike the back, H E, C B; take the compasses and divide the back into any number of equal parts, as at H G, F E, C B, Fig. 57. Here

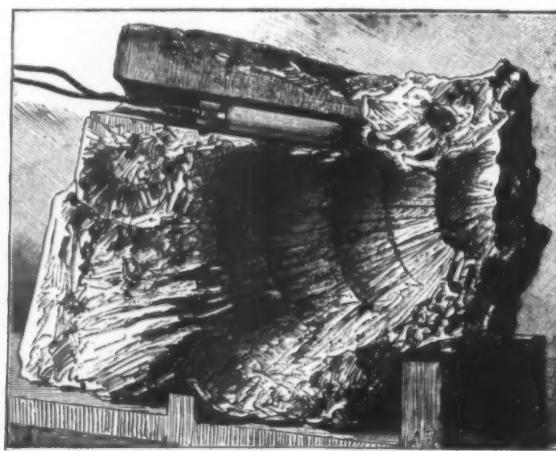


FIG. 5.—BLOCK OF STEEL FROM A 20 TON CANNON SHATTERED BY DYNAMITE AND ELECTRICITY.

selves have for some time past been executing, we have made almost exclusive use of this machine, which is very portable, and which, with its simple arrangement of ebony disks and Leyden jars, is not easily apt to get out of order, or is at least readily repaired by the experimenter himself.

In the shops belonging to public works, as well as in military campaigns, where a machine must be put into the hands of laborers or of common soldiers, it is absolutely necessary that there should be combined in the apparatus simplicity and certainty of operation. As regards the installation of the blasting apparatus itself, and the arrangement of the wires or primers, it should be well understood that there is nothing to be changed in what we have above explained, whether one or the other of the systems exhibited at the Palais de l'Industrie be employed.—Maxime Helene.

EQUIPOTENTIAL LAW FOLLOWED BY NOBILI'S RINGS.

THE author refers to the fact that on placing above a metallic plate, forming the bottom of an electrolytic vessel, points of any number attached to the conductors of a battery of strong tension, the colored rings which take their rise always correspond in a striking manner to the equipotential systems which take their rise on applying directly, upon an isolated plate, poles of signs contrary to the former. Hence a natural assimilation of the phenomenon of dynamic efflux to simple phenomenon of static induction, and the necessity, theoretically, of considering the liquid as an almost absolute insulator, in which the passage or efflux of the electricity can take place only by following the minimum tract from the point to the plate. This latter fact, little in accord with the original figures of Nobili and with current ideas concerning electrolysis, has been verified experimentally by the author, who has studied, under strongly concentrated illumination, the liquid currents from one electrode to the other, rendered visible either by the transportation of material particles, or by the disengagement of gases which accompany them. These latter are produced in great abundance in the double tartrate of antimony and potassium, between the positive plate and the negative electrode. Myriads of microscopic bubbles move in dense files along the plate till in close vicinity to the electrode, and then rise suddenly with an abrupt curve, following its surface to the upper surface of the liquid. What can these trajectories be but lines of force of the electric efflux? Kirchhoff has shown long ago that the quantity of electricity which traverses each element of a conductor of finite dimensions must

you have 5 in. set off, from B to H, Fig. 54. Cut the pipe to about the shape shown in the dotted lines, then place the point of the bolt or tommy (Fig. 23) at A, Fig. 54. Work this up from the throat or lip, A, Fig. 55; then take the small point, P, of your dummy, Fig. 38 B, and place it inside the pipe at about E, and with the mallet or small dresser work the point, B, and the sides, F, up to the proper shape. It will come up better if you open the sides, F, with your tumbler, P R, Fig. 50.

I have found the best method of cutting these knuckles is that described in Fig. 56. It is done for small-pipe work, by



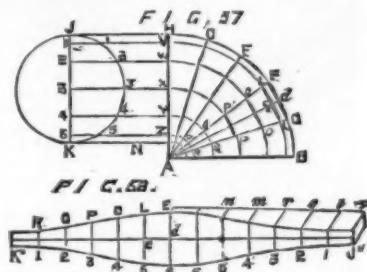
first boring a hole, A, and with the chipping-knife (a knife having a leather-covered handle, obtainable at any tool-makers, and similar to a hacking-knife, excepting that it is stronger) cut the slit, J, and round the ends off as at F, then drive the turnpin up and open the side, F K; next with the bolt make the throat or lip, as shown at A, Fig. 55. Now with the mallet and dummy, work the end, B, and sides, F K, up, as that shown at Fig. 55.

THE THEORY OF BENDING (Fig. 57).

A few lines respecting the theory of bending may not be out of place here: Fig. 57 will assist in the description. Let J K be the size of your pipe to be bent. Draw the right line, J K. Divide this pipe into, say, five parts, as shown at 1, 2, 3, 4, 5, on the circle. Next draw the lines J H and K N square to the line, J K; now strike the line H A, also square to J H, and anywhere on this line, as at A, strike the throat line, also the back, as at H G, etc. Draw the parallel lines V 1, W 2, X 3, etc., through the divided part of the circle, and strike the curved line, V L W O, etc. Next divide this curve from H to B, into five or as many parts as you choose, as shown at H G, F E, C B, and also divide one of these as at A d, and draw straight lines from point to point, as at L L, O O, P P, Q Q, R R; next strike the line J K, Fig. 58, and measure off from J 1, in Fig. 57, and set

this distance on J 1, Fig. 58, thus measure from 1, 2, Fig. 57, and set this off on Fig. 58, and so on until the whole is marked off. When all is marked off and laid down as from J to 6, Fig. 58, continue from 6 to K, which will be the exact distance round the bend. From d to E, Fig. 57, measure off the distance of the short line, and place this on the line, K J, Fig. 58, as at E d and d 6; also measure off L e, Fig. 57, and place this on the line, L e, Fig. 58, and so on until you have the lot. Now draw the curved line through the distances or points, R 1, Q 2, P 3, O 4, L 5, F 6, and this will be a development of one section, H G, Fig. 57.

Now, seeing this, it is quite clear that when the pipe was in a straight line, the back and throat were of equal length and substance, therefore the piece 58 across R 1 was the



same as that across E 6; this being the fact; when pulling up bends at Fig. 46, the molecules of lead must be either driven as it were into a heap at R 1 (but less so at Q 2, P 3, etc.), or worked from K toward E, that is, if you are not to strain the back; but if you work away by hammering the back out, you do not require to thicken the throat part.

I must now direct your attention to the "Split made Bends," Fig. 44. In this case you can take away the surplus lead without trouble.

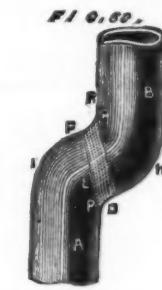
Now turn to Fig. 55. Here we have the back the thickest part—just what is required, for here it is that the friction of the water takes place with vertical soil-pipes.

DAVIES' SIMPLE "SET-OFFS," OR KNUCKLE-JOINT SET-OFFS.

Fig. 59.—The knuckle-bend may be converted into a



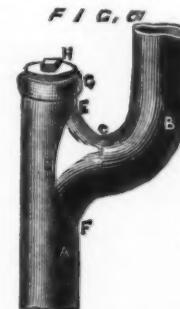
simple "set-off" by the method illustrated in diagram 59. In this diagram you are shown that the pipe, B, enters A, similar to that at E G. After preparing this for a joint, it is finished as at Fig. 60, and makes good sound work. One



thing is certain: this set-off is strongest at the part where strength is most required.

DAVIES' CLEANSING SET-OFF.

This is another simple set-off, made either with a bend or knuckle joint. This set-off has a cap and screw, H, cleansing the soil-pipe. This requires no further description, and



its working is all that is required at about one-fourth the cost of labor in making ordinary set-offs. I am pleased to say that these are the first on record.

To complete my instructions on "Bend-making," I must describe the method of making bends in the center of a long length. Assume that you have a ten foot length of soil pipe and you require a bend in the middle of it, and again assume that you have not any long dummies; you should slit the two sides (as at D B, Fig. 44), at the point where you require to make the bend, say, 12 in. or 18 in. long, pull the lead open and then your pipe round, work the lead truly round with your tools from the inside and outside of the bend; when you have soldered up the seam your bend is complete.

* From the London Building News.

FEBRUARY 11, 1882.

ELBOWS, SOIL-PIPES, AND TRAPS.

Elbows are frequently made to save the expense of proper bends. They are exceedingly useful for rainwater-work, though often used for closet-work. When used for the latter purpose, the pipe should have as much fall as possible, though actually elbows should not be used in closet-work, unless it is from a nearly horizontal to a vertical soil-pipe, such as would occur from the outlet of a trap to the down-pipe.

Fig. 62 is a finished elbow. A being the part coming from the trap, B the soldered part of the elbow, D the down or

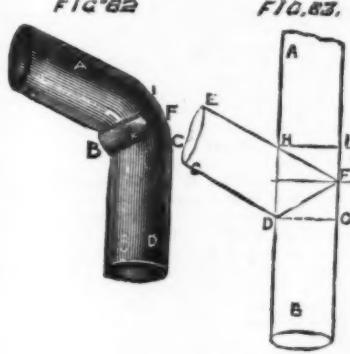
carefully away you often save yourself the trouble of driving.

DRIVING SOIL-PIPES.

This is done by driving a short length of mandrel through the pipes, to take out the dents or bruises. For this purpose a piece of $\frac{1}{4}$ in. gas-pipe, or a length of ridge-roll, is frequently used.

STINK-TRAPS AND THEIR VARIETIES.

Stink traps, as you will see by the "Alphabetical List," have many titles. I do not pretend to treat half of the



vertical soil-pipe outlet. In this instance you will perceive that the elbow will work equally well as the bend, because the fall is good, and the soil tumbles over the throat of the elbow direct into a vertical pipe.

There is, comparatively speaking, no skill required to shape such a piece of work: all you have to do is set your elbow out on the floor or bench as shown at Fig. 63, A B being the straight pipe, B, though commonly called the rake or fall line. Here you see that this line cuts the straight line in D, and E cuts again the pipe-line at F. Draw the dotted lines, D G H I, square to the pipe, and cutting the points, D H, then from I to F. F to G will be the size of the piece to be taken from the throat, if you desire to make a true elbow.

This exact method here explained we seldom or never adopt; but instead, only cut three parts away, and the other part use for lap and for allowing the elbow to be worked round at the back as at I F G. In this case the solder need not be taken all round, but finish as shown at K. There is one thing important in elbow-making (which many think and say is unnecessary for me to mention, and so far as thoroughly intelligent workmen are concerned it is quite right, but there are other than thorough practical men whom these articles are intended to benefit), always well work the lead down the throat of the elbow at B, Fig. 64. This prevents hair, etc., etc., lodging at this point.

SOLDERING ELBOWS.

Having soiled the elbow, shave it to about 1 in. wide for the outside, and $1\frac{1}{2}$ in. wide for the inside. Shave it first or before pulling it up together, then pull it up as at Fig. 64



and from the points, A D. Tie the ends together with string, and solder up the throat to appear as shown in Fig. 62.

SOIL-PIPE MAKING.—COPPER BIT WORK.

This work is very easily learned. Take a piece of lead wide enough to wrap round a wooden mandrel, the size of the required pipe, and say 10 feet long; place the edges true one with the other, wrap the lead round the mandrel and withdraw it, then soil the pipe, and with a gauge-hook the desired width $\frac{1}{4}$ of an inch, after which tack the lead together every 10 or 12 in., and solder it down, using rosin freely. The larger the copper bit the better chance you will have to float your work.

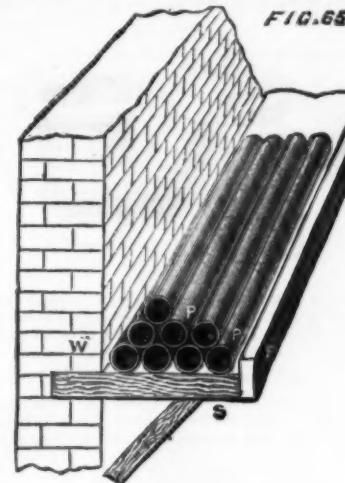
DRAWING SOIL-PIPE WITH POT AND IRONS.

This requires a little more care and practice than the last-described method of work. Proceed as follows: Having prepared the pipe as for copper-bit work (except the shoving), shave it at least $\frac{1}{4}$ in. wide, or with a gauge-hook $\frac{1}{4}$ in. blade, this will make a $\frac{1}{4}$ in. seam. Now take a ladleful of hot solder, your mate holding the edges of the lead together, you pour a little solder across the seam every 8 in.; this will keep the edges up in proper position. Then take red hot iron, and with a strap of lead burn the two ends together; this is most easily done by your mate holding an old felt under the seam. This done, all is prepared. Take the ladle in your right hand and the iron in your left, pour some solder upon each side of the seam, and get up the heat; then with the red-hot iron draw it first on one side, then the other of the joint; this causes the solder to flow down the pipe; at the same time you must keep pouring fresh hot solder upon the joint. Suppose you have a start of 9 in., or, in other words, 9 in. soldered, then let your mate start 6 in. from you, and with a sponge pour a little cold water on the seam—this prevents the pipe opening; thus you work down the pipe, your mate following with the sponge. If by chance a little solder hangs to the side of the seam, the mate should push it away with a little stick.

N. B.—The bend should have a fall 1 in. in 10 ft.

STACKING SOIL AND OTHER PIPES.

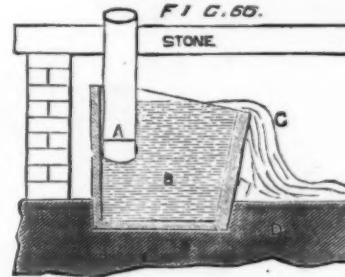
Soil and other pipes should be properly stacked away. One of the best methods is shown at Fig. 65; it is simply a shelf having F nailed on the front; by stacking the pipes



number of names known, but only those in general use. There are the Antle trap, Balance trap, Ball trap, Bath or belly trap, Bowl and Pipe trap, Branch trap, Cistern trap, Circular trap, ω trap, Davies' trap, Dip trap, Eclipse trap, Fat or Grease trap, Flap trap, Float trap, Flower-pot trap, Gully trap, Half ω trap (Helyer's), Hunch trap, Intercepting trap, Inverted Cup trap, Knot trap, Lip trap, Mansion trap, Mansion ω trap, π trap, ω trap, Siphon trap, Side trap, Signal Alarm trap, Sink trap, V trap, Ventilating trap—all of which have been made of lead. The above are only a few quoted from memory, and are only a portion of the multitude, and yet nearly all are subject to, and dependent upon, the same law of action—viz., the water-seal. We are told that Glauber, the old chemist, knew the value of the water-seal or Stink trap, and I quite believe he made use of what we now call the Bell trap, as a water-lute or valve for arresting his chemicals or gases, and to this day we, together with the first chemists of the land, are glad to use this simple contrivance as a governor or check against mephitic gases.

The simplest made of all traps for sanitary purposes is that known as the bowl-and-pipe-trap, mostly used for rain-water-pipes, sinks, bath wastes, etc., etc., especially when these pipes empty themselves into the old-fashioned "brick-trap." I have personally, about twenty years ago, taken six, or in some instances, ten such ends of pipes, into one bowl or cistern; for instance, on the Campsbourne Estate for the late Mr. John Jury, who was greatly in favor of them.

I always endeavor, even now, to carry the ends of waste or other pipes (excepting soil-pipes) into the water of an



outside gully-trap, as, by so doing, all draught is prevented from coming up this pipe; it also dispenses with the necessity of another trap being fixed inside or just below sink. This trap is neither more nor less than a bowl of water, having the end of a pipe dipping into it as at A, Fig. 66.

Here you see the bowl, B, which may be made to any shape (round bottom is best), and of any material (in the olden days it was of lead); now it is not unfrequently a common flower-pot with some Portland cement dropped to the bottom.

I must ask my readers to take notice of this trap, as I think it was the first step toward the invention and adoption of the well-known ω trap, the history of which I am endeavoring to trace.

HALF ω -TRAPS OR SIPHON TRAPS.

A simple curved pipe or tube bent in such a manner that it will retain sufficient liquid to bar the passage of lighter fluids, is, among plumbers, known as a trap, but how long such traps have been in existence no one can tell. Suffice it to say that siphons have been known hundreds of years before the Christian era. They answer for many sanitary purposes. Fig. 67 is the shape of the siphon trap now in general use, with cap and screw, which may be cast, worked, or bent up out of a straight length of pipe or in sections, but generally when hand-made in two halves from sheet-lead.

The cast ω -trap is much used in London and its vicinity, and the hand-made or sheet-lead trap is used, comparatively speaking, all over the world; within the last five years they have been made by hydraulic pressure—i.e., pressed into their shape in a method somewhat similar to that adopted in making lead-pipes. This method is undoubtedly the best, inasmuch as the lead is, as a rule, much more solid than when cast. In some instances, such as where there is a long outgo required, the hand-made ω -trap would be preferable, which, for closet-work, avoids a 4 in. joint, thus saving four or five shillings.

I shall now proceed to explain the method of striking the form of these traps geometrically.

HALF ω -TRAP. (FIG. 68.)

For a 4 in. trap open the compasses to about 1 in. so that you may strike the half-circle, R W X, Fig. 68, then draw the right line, U Y, cutting the point, Z. Now open the compasses so as to strike the bottom arc, D Y U, which must be 5 in. or 4 in. (the size of the trap) from the throat line, W, to, D. Next draw the line, B C, parallel to U Y, and cutting the bottom or belly of the trap at D; then take the compasses with the radius, Z D, and from a point on the line, B C,

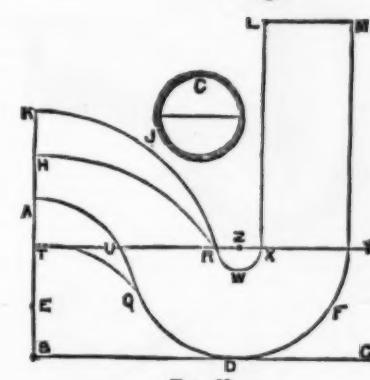
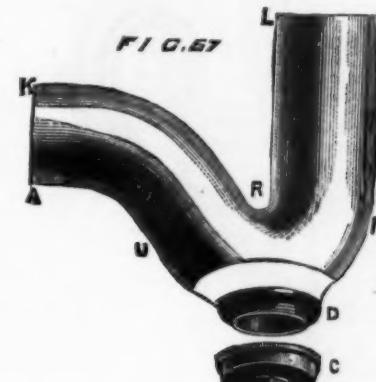


FIG. 68.

strike the outgo (shown on dotted line), T Q, cutting the neck of the trap as at Q; this forms an easy outgo. Open the compasses, and with a radius of B to R, strike the top, H R, cutting the throat at R. This will give a 1 in. dip water-lock or seal. Next draw the line, K B, cutting the point, B, and perpendicular to B C, which will give you the square line for the outgo; but should you require more water-lock, then, instead of striking the neck as per dotted line, go higher up for the center, as at the point, E, and with the same radius (Z to D) strike the neck line as at A U Q, and open the compasses to R for the top line, K J R, which completes the pattern.

I have lately made some experiments with these traps, and find that 2 in. water-lock is better than 1 in., owing to this kind of trap waving its water-lock away, especially where well ventilated. I have given this diagram a water-lock of 3 in., which, to a great extent, gets over the difficulty of waving out; but this extra dip is greatly against the action of the trap for self-cleansing purposes, as the soil must take a great dive before it can reach the outgo.

 ω -TRAPS. (FIG. 69.)

These traps are nothing more than the bottom of the half ω twice struck. If you require more or less water-lock, make a difference in the height of where you place the point

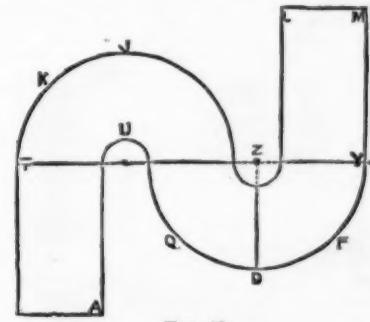


FIG. 69.

of the compasses, in striking the outgo. That is to say, if you require less dip, strike the throat, U, lower down, and if more, vice versa.

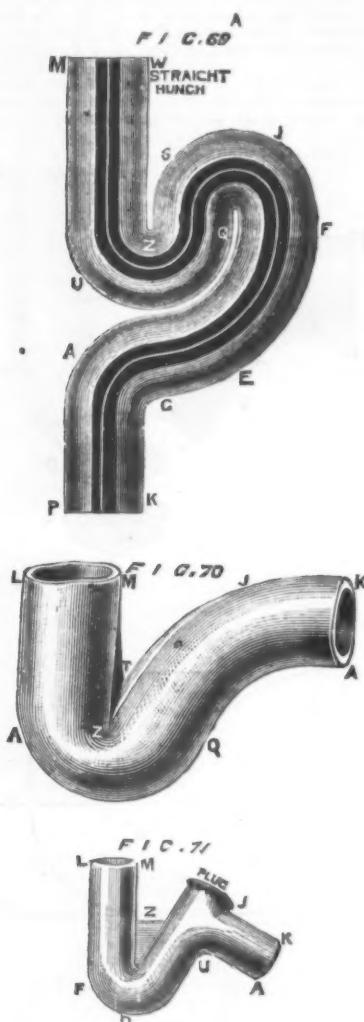
HALF-HUNCH TRAP.

This trap is nothing more than the ω -trap with the outlet continued to come in a straight line with the inlet, as at P K, Fig. 69 A. In making this trap, make M U Q A P first, and fit W S J F E G K to it. These traps are handy for rain and other water-pipe work requiring a trap out of the way, especially for fixing in a brick chase. Also see Fig. 88, A.

STRAIGHT DIP ω -TRAP. (FIG. 70.)

This is a trap I experimented with some fifteen years ago, and went so far as to have a set of moulds made for casting them, but was better engaged after that date. The object I had in view was to make the trap more thoroughly clear itself of soil, etc., so as to prevent it diving so low into the water. I found that by doing so a 3 in. water-way was equal in efficiency to a 4-in. round pipe throat or passage.

SUTLIF'S CAST \square TRAP. (FIG. 71.)
This trap has been cast with cleansing-cap, and screws, J.

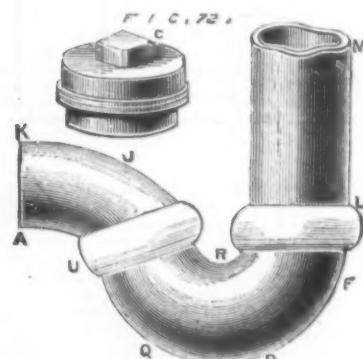


on top of the outgo. It has also a tie, Z, across the throat to prevent its being pulled out of shape.

\square TRAP MADE IN TWO PIECES. (FIG. 72.)

First, you require a block the shape of your trap, or block in two halves, the seam being on the side (that is, if you have many to make), and two rings made in such a manner that they can be slipped over the block and the lead, and with thumb-screws screw together, so as to hold the lead upon the block, while you are working it to the shape of the block.

Now for the size of your lead: Take a strap of lead, say, $\frac{1}{4}$ in. wide, and measure round the trap from M F D to A (Fig. 68). This will give you the length for the bottom. Now take the circumference of the trap to get the size. Half this will be the width for you to cut the lead, which must be cut truly, and with planed edges. Next, just where the lid is to fit D, take the mallet and hollow your lead a little, not to thin the lead, but just to fit the bottom of the block, then offer it on the block and end up the inlet end; take the ring and fix it on this part of the block. Next bend up the arm from D to A, and with the other ring fix it there, then



with your tools (a bossing-stick will do) work the lead to the shape of the block, taking care to drive the molecules of the lead in the direction you require them to flow, and be sure that the lead is of uniform thickness; in like manner do the throat or top part. Care must be used to hollow and fit the lead to as nearly as possible the proper shape, by first turning it back, and with the bossing-stick well drive up the throat part, C, in plan (Fig. 68). This will thicken the lead; after which place it upon the block and bend over the back to the outgo, and with the rings fix it there, then work it to fit the block.

I have before said this should be in two halves; this will give you a line to trim your lead to, should you require it trimmed off for soldering.

The next thing to do is to solder it up, which may be done with the copper-bit, wipe it, or burn it. The last-named is much the best.

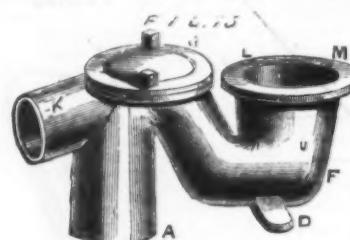
\square -TRAPS MADE IN THREE PIECES.

This is a very old method of making \square traps; the bottom, Q D F, is cast, the dip, M L, soldered or burnt on, as also the outgo, A Q J: A drawing of a trap weighing over $\frac{3}{4}$ cwt., lately taken out of an old house in Knightsbridge, illustrating this method, is given in Fig. 73.

\square -TRAP WITH LUGS FOR FIXING ABOVE FLOORS. (FIG. 73.)

Fig. 73 is a diagram of an \square or half \square -trap for fixing above floors, suitable for short or low balloon basins.

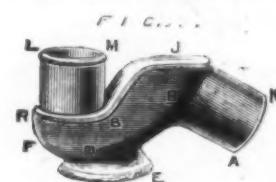
This trap may be made with cleansing cap and screw, and can be wiped down to the soil-pipe at A, or on a straight out-



go. This style of trap has been made in earthenware, but the difficulty has been to make the connection with the lead and outgo sound. This difficulty has been overcome by making the trap of lead instead of earthenware.

THE SEMI \square -TRAP. (FIG. 74.)

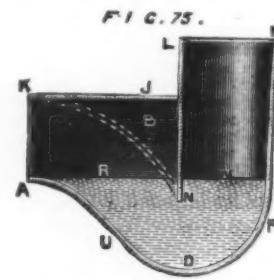
This is another trap for fixing above the floor line, and excellently well it answers its purpose. The bottom part, D H R, of this trap may be bossed up on a block or otherwise,



and the top or inlet soldered on, so that the lower part, R B, forms the water-lock. The foot, E, is also soldered on. Of course, this trap can be fixed below the floor-line with the outgo soldered on in the usual way.

THE ECLIPSE TRAP. (FIGS. 75, 76.)

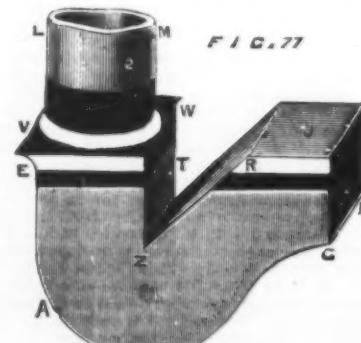
This trap is a good and useful one, having a dip, N, with rounded bottom and top; an air-chamber, B, which prevents wearing out (the great fault in the \square -trap).



The Eclipse is cast in one piece of lead. Fig. 76 is the elevation of it, showing that the whole is rounded, which, in the estimation of many sanitary engineers, is a great advantage.

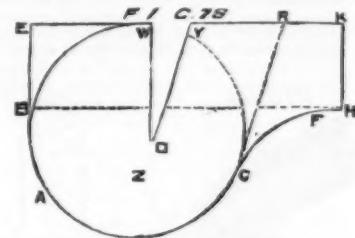
V-TRAPS. (FIG. 77.)

This excellent trap is, in principle, part \square and part \square



siphon. Z is the cheek; T the throat; J the top, which also goes down to form the throat, and up, then over to the top to V; the top or inlet-pipe is soldered on last.

The method of cutting out this cheek, Z, is as follows: First strike the circle, A W C, Fig. 78; draw the right line, E K, cutting the top of the circle; next draw the line, K square to the top line, and cutting the circle at B; then measure off the outgo, R, with the distance from E, to the extreme periphery of the circle at C; now, with a straight-



edge, draw the outgo line, R, to cut the edge of the circle, as at C, then draw W D square to the top and the slanted line, Y D, taking care to go low enough at the throat in order to have a good dip. Prepare this cheek and solder on the band, as at K G A E, Fig. 77, then the top, and dip in another piece, after which, solder on the inlet pipe, L M. Of course, the throat part and up T W Z to R is soldered from the inside, and the part R E after. Messrs. Beard, Dent & Hellyer make a cast trap somewhat similar to this last described.

\square -TRAP.

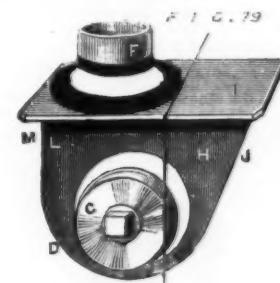
This trap has stood its ground for at least 200 years, and there can be no doubt it had its origin from the dip pipe and bowl trap, then to the shape of the \square -trap (to be explained shortly), then altered again to its present shape of a \square .

But, in whatever way this trap first originated, there cannot be a doubt that it has lately got into sad disgrace with many who do not know its merits.

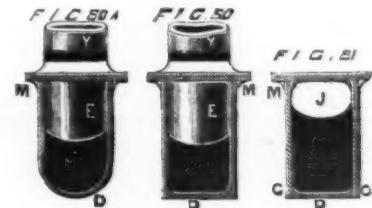
The \square -trap has been made by many plumbers, who never thought it was wanted for anything more than the keeping back of stinks; they have made it to almost any size and shape, not troubling or caring whether it cleared itself or not.

I shall now show the best method of making it, so that it shall be what is generally known as self-cleansing; at the same time I shall keep within the bounds of that principle, which, I suppose, is universally known to be the beauty of the \square -trap—viz., the clearing the soil from the inlet to the body of the trap, and its retaining the water-seal or lock, especially against the waving out caused by strong currents of air blowing down air-pipes or up soil-pipes.

Fig. 79 is an elevation of the \square -trap, having a cleansing cap and screw, C, soldered into the side or cheek; this latter



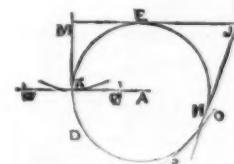
being fixed here, is more for sink work than for closets—in fact, the proper place for this cap and screw for closet-work is at L. In order to get at it, I have made \square -traps with the dip to screw in and out, but for sink-work it is best at the side or under the bottom, as at D, Fig. 80. This allows



you to take such things as tooth-brushes, etc., out of the dip, which cannot pass into the body of the trap.

Fig. 81 shows the outgo from the inside of the trap. Fig. 82 shows my geometrical plan for striking out the cheek of a self-cleansing \square -trap.

FIG. 82.



The novelty of this is obtaining the point, J, so that it will make the same angle in any sized trap—viz., the angle of 76°.

To strike this, take a piece of lead, having one straight edge, as from M to J, open the compasses to, say, 4 in., and scribe the circle, D E H, cutting the line at E, then with the square, M to K, also cutting the circle at K. Next and most important, place the point of your compasses at the intersecting point, M, and with the other obtain the distance to the outside point of the circle, as at H, and as shown at O P are; then, having obtained this exact distance, set it off along the line, M E, as at J. This is the length of the top. Next from the point, J, draw the outgo line, J H, and this will be the proper angle to allow the water to rush and sweep

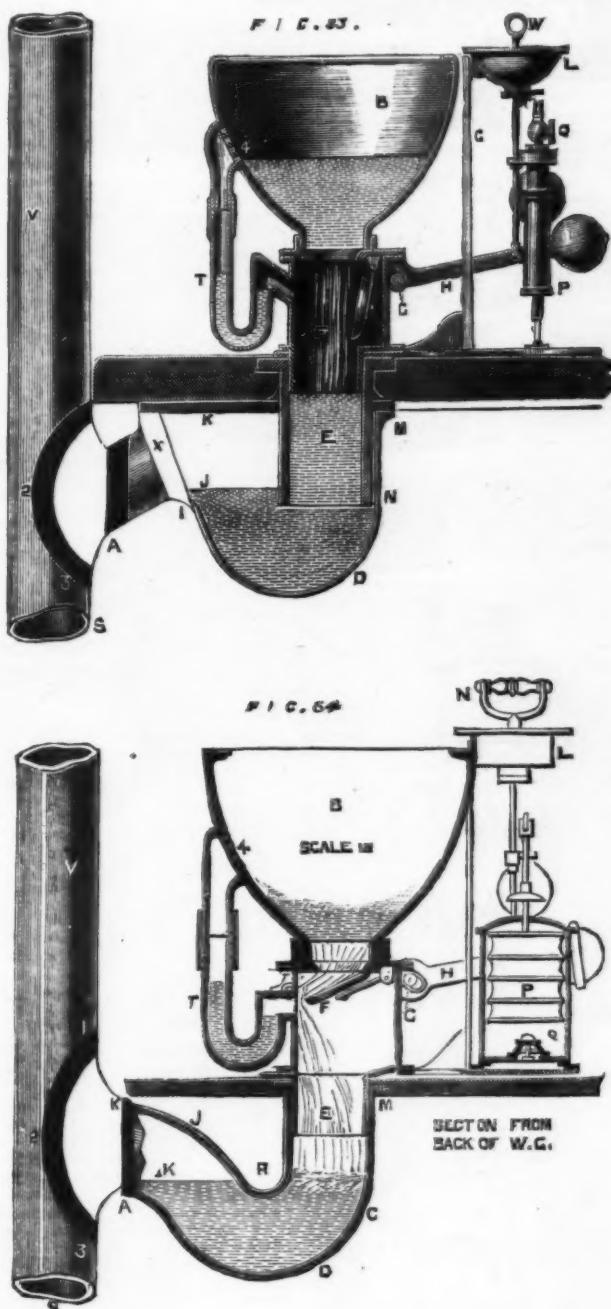
everything from the dip, along the bottom of the band, and out into the soil-pipe.

The next thing to be considered is the depth of this trap for self-cleansing purposes; this is governed by the size of the dip-pipe, E (Fig. 80). Suppose the dip pipe to be 4 in., and the outgo pipe the same, then the 4 in. outgo will take up 4 in. of the cheek, that is from the top down to the soil-pipe or outgo, as at K J, Fig. 80, so that this must be 4 in. Then you must have the dip longer than this to get the seal—which should never in any case be less than $1\frac{1}{2}$ in. to $1\frac{1}{2}$ in.—here in this case the bottom of the dip is $\frac{1}{2}$ in. down the trap; then you should have 4 in.; or the size of the dip pipe, between the bottom of the band and the lower edge of the trap. This would be a $9\frac{1}{2}$ in. trap, but this is not wanted, for $8\frac{1}{2}$ in. will be plenty for the space between the bottom of the dip and band, which, on account of being, so to speak, here contracted, the water will have a better scouring action on the bottom of the band, and the band being square or flat, will allow the soil, paper, etc., to go freely away; in fact, although you have only $3\frac{1}{2}$ in. between the band and dip, there is more water-way than through a 4 in. pipe. The next part to be considered is the width: this should be for a self-cleansing trap, only just wide enough to admit the dip, whether 1 in. or 6 in.; therefore, if you

On lifting the handle, W, Fig. 83, it brings up the lever, H, with it the tumbler pin, G, and the crank which works an axle having the loose valve, F, attached; the water then runs the full bore of the dip-pipe into the trap, striking against the band at D; it then flies off at a tangent to the point, J, where it again strikes into the soil-pipe, X, and down the pipe. S, the air-pipe, V, allows it to travel onward without dragging air through the trap; but should there be a strong wind blowing down this ventilating-pipe, or upward from the sewer, etc., the air presses flatly, so to speak, on the surface of the water, and so keeps it steady. Having, I think and hope, made the working of the \square -trap clear to my readers, I must now refer to Fig. 84, in which I shall endeavor to show the working of the \square -trap.

THE WORKING OF THE \square -TRAP.

So far as the closet apparatus is concerned, you have the same work as you had in the \square -trap. But the difference in the action of this and the \square -trap is that owing to the shape of the \square -trap; the wind on blowing up the soil or down the ventilating-pipe, plays on the water at K, causing it to rock rapidly owing to the shape of the trap. This possibly goes on for ten or twelve hours, but, perhaps, only a few seconds. This rocking motion of the water causes it to ebb



use a 4 in dip-pipe, make the trap only wide enough to admit this pipe.

I have proved, beyond the shadow of a doubt, that if the \square -trap is made according to the following rules, it will never fail in doing its duty as a self-cleansing trap, and supersede all others at present invented.

Rules.—First: The depth should be twice the diameter of the dip pipe, in addition to the necessary depth of the seal, which, in a former paragraph, I have said should not be less than $1\frac{1}{2}$ in. to $1\frac{1}{2}$ in.

Secondly: The band or width of the trap must be just wide enough to admit the dip.

Thirdly: The outgo soil or waste-pipe must never be less in diameter than the dip-pipe.

Fourthly: That when soldering on the outgo or waste-pipe, the top of this pipe should be brought up to the top of the trap, as at K, Fig. 83, and be as smooth as possible, and without sharp edges.

Fifthly: Keep the dip-pipe close up to the heel of the trap as shown at N, Fig. 83.

THE ACTION OF THE \square TRAP.

Junior plumbers will do well to notice the details of the action of the \square -trap.

out through the outgo of the trap; thus, the so-called \square -trap ceases to be a trap, and becomes only a snare.

This I venture to suggest is a sufficient reason for all sanitary engineers to condemn the \square -trap, and, until they can find something to supersede it, use the D, which, I must repeat, and have already proved publicly, is the best trap yet invented.

(To be continued.)

THE OPTICAL REQUIREMENTS FOR PHOTOGRAPHING ON A SCALE OF NATURE

THERE are many scenes in nature, especially those situated at some little distance from the observer, which, however grand and expansive they may appear when looked at by the eye, assume upon the ground glass of the camera and in the finished photograph a tame and dwarfed appearance. The distant mountains are represented as though dispossessed of their grandeur, and, in the case of marine views, the pretty islands and jutting promontories are merged into an uninteresting strip devoid of detail.

A view that imparts pleasure and suggests ideas of grandeur to spectators does not necessarily make a good photograph. Dimension is an element which exercises a powerful

influence in having a scene properly depicted by photography. A subject may be taken by two different cameras, one of them large and the other small; but, while in the accuracy of their drawing, as well as in light and shade, both shall be similar, yet the larger one will convey to the spectator ideas quite different from the other. One will insensibly approve itself as a true transcript of the scene it purports to be; the other as a mere dwarfed edition of the same. Why is this?

It is quite easy to photograph a view so that it shall be depicted either in telescopic representation, or on a scale of much smaller angular magnitude than that presented to the eye by the scene itself. By the selection of a suitable lens for the purpose, the difference between two views taken from the same standpoint may be as thoroughly distinct as will be the examination of the scene, first through the large end of a telescope, and then through its small end. The one magnifies, the other diminishes, and so it is with a photographic objective.

Between the two extremes there is a medium focus by which objects are depicted in the same apparent dimensions as shown in nature. But this focus is by no means an arbitrary one, for it will have to vary, within a certain limited range, to suit the various kinds of sight. However, from several experiments, fifteen or sixteen inches may be assumed as the focus of the lens by which a picture can be taken that will present the most natural appearance. The data on which we give this focus is as follows:

From ten to twelve inches is the distance at which the human eye, in its normal or healthiest condition, sees an object most distinctly; that is to say, a photograph, engraving, or similar object will be seen with the greatest plainness when held this distance from an eye in its best condition. If a plate of glass were held at this distance so as to intercept a view of nature, and if, then, by closing one eye and making use of a suitable pencil, the outline of such view were traced on the glass, it would represent the scene on a scale precisely similar to its natural appearance. To photograph a scene under similar conditions of magnitude, it is only necessary to try first one lens and then another until the image on the ground glass shall, when examined at a distance of ten inches, subtend the same angle as any object in the scene itself. This condition is fulfilled, as we have said, by employing a lens of fifteen inches focus, or, preferably, one of an inch or two longer. When such a focus is exceeded to any considerable extent the view becomes a telescopic representation, the various objects appearing larger than when seen by the eye in nature. The knowledge of this is desirable when a limited portion of a distant scene is required.

Conversely to the foregoing, all views taken by lenses of less than fifteen inches focus are delineated on a smaller scale of angular magnitude than the natural scene. It is only, however, necessary to examine such a picture through a magnifying glass of even low power to convert it into a telescopic image—that is, one larger than it seems in nature. And it is one of the charms of a portable, or even pocketable, photographic camera, that it produces pictures, which, when sharp and properly lighted, are not only pretty in themselves, but also capable of being magnified or enlarged to mammoth dimensions. A transparency three and a quarter inches square may not, from the diminutive scale upon which the objects, especially the distant objects, are depicted, convey to the mind of the spectator much idea of grandeur or detail; but let that transparency be enlarged to ten or twelve feet by the lantern or stereopticon, and then its aspect is totally changed—for, owing to this magnifying process, many objects in the scene, which would be invisible to a spectator standing alongside of the camera while the original negative was being taken, are now depicted in telescopic dimensions.

Apart from the utilizing of small pocket-camera negatives in the manner described, they may be enlarged three or four diameters—or, say to twelve or fifteen inches—without any appreciable loss of sharpness; and a negative of such dimensions, reproduced from a small one, will yield prints possessing every pictorial merit in quite as high a degree as if the landscape or tourist had been cumbered with a camera fitted for taking fifteen-inch negatives direct.

But to go into the details of reproducing negatives on a large scale would unduly lengthen this article, and hence it must stand over for treatment on some future occasion.—*Photographic Times.*

A CURIOUS CRAFT.

PERHAPS the strangest piece of naval architecture ever floated is that which Mr. R. M. Fryer has been testing the past summer on Harlem River, in the upper part of this city.

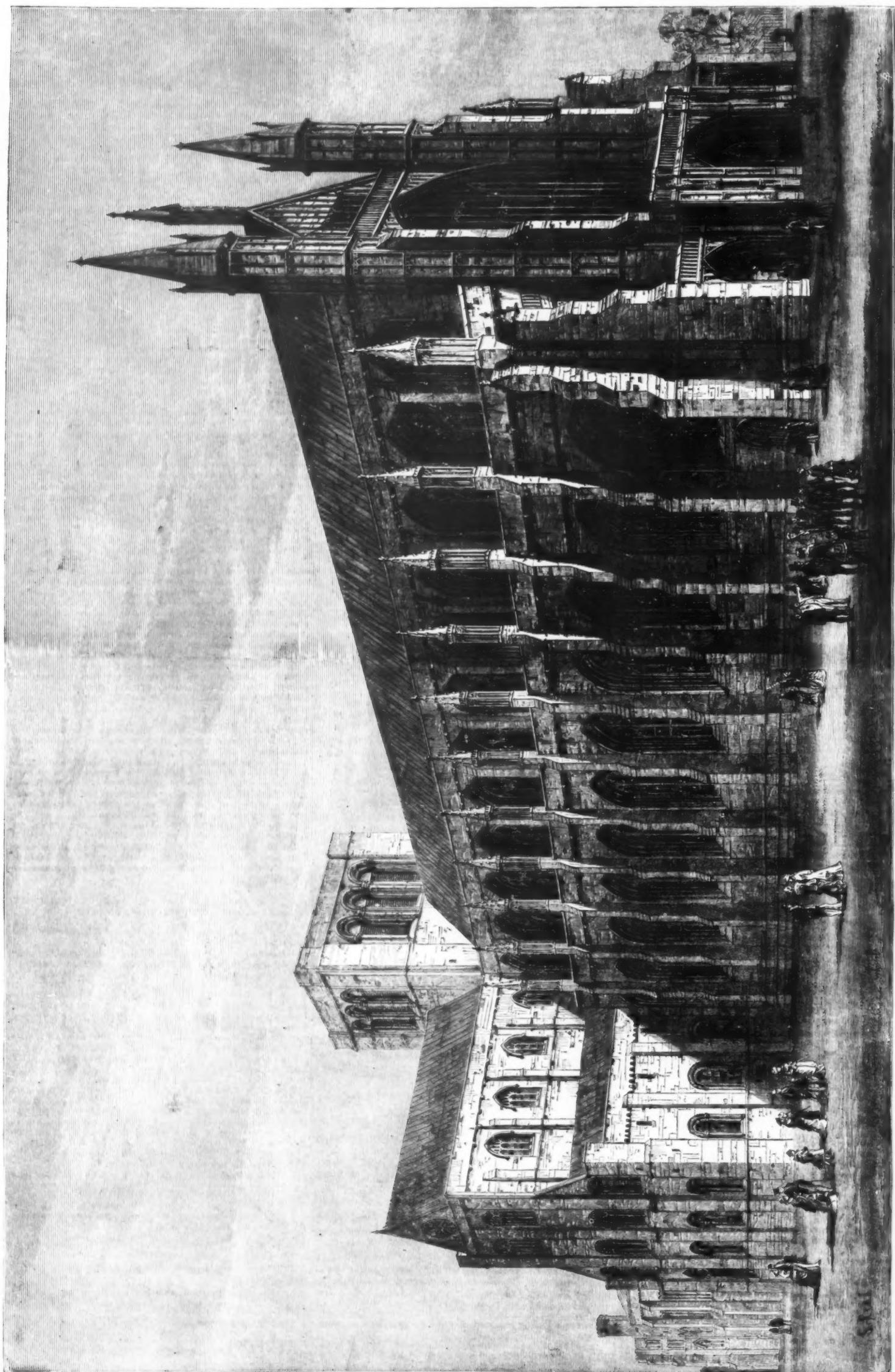
The model consists of a passenger carrying framework resting on three globular floats. These globes are each six feet in diameter, and are arranged in the same relative position as the wheels of a tricycle. Each globe revolves on its axis like the wheels of a paddle-wheel steamer, being driven by steam power. Each one is a propelling wheel, having flanges affixed answering to the buckets of a paddle-wheel, and striking and acting on the water in the same way. The three globes are held in their relative positions by a rigid framework on which the engines, and whatever else the craft may carry, rest. This framework composes the ship. It rests upon the axles of the globes in such a way as to be always clear of the water—dry on the under and upper side alike. Its weight, added to the weight of the buoyant globes themselves, is so graduated as to submerge about one-quarter of the diameter, or one-sixth of the volume of the globes.

For actual service the inventor proposes to make the globes sixty feet in diameter.

Among the points he claims to have demonstrated by the workings of his model are the following:

- That at least as far as the model is concerned a given amount of power will drive it further and faster on the water than on a level track, which indicates the possibility of attaining as great speed on the water by wheels as on railroads.
- That obstructions placed in the path of the wheel in the water are more easily ridden over or deflected the wheel with less jar or damage than they would on land.
- That the vessel can be guided by the wheels or globes as readily as by a rudder.
- That in rough water there is a minimum strain on the body amidships.
- That the globe wheels run readily out of the water and up a steep plane as a beach; or that they can be run on a track by lifting the keel of the globe.

The next step proposed by Mr. Fryer in the development of his theory is the construction of a vessel with twenty-four foot globes, which will, he thinks, be at once a serviceable ship for practical purposes and demonstrate the feasibility of his ideas beyond a question.



WINCHESTER CATHEDRAL.—DRAWN BY S. READ.

THE GREAT WALL OF CHINA.

THE British naval squadron lately cruising on the coast of China, under the command of Captain East, H.M.S. *Comus*, was composed of that ship, the *Encounter*, the *Curaçoa*, the *Pegasus*, the *Albatross*, the *Fly*, the *Mosquito*, and *Zephyr*. On Midsummer Day, it anchored off the seaward end of the Great Wall of China. We are indebted to an officer of the squadron for two sketches of this interesting subject. The famous wall, he tells us, is a great earthwork, revetted entirely with brick and stone on the outside. Though built two thousand years ago, it is in wonderfully perfect condition. The sea end is a large fort, which has been restored. This fort is manned by about two hundred Tartar soldiers, fine-looking men, with wretched muskets. The fort is partially armed with cannon, but no ammunition was seen. The commanding officer, a mandarin, received the British naval officers who landed with much civility. He told them there were 40,000 Chinese troops in the neighborhood. This was probably an exaggeration, but there were several camps, protected by an earthen rampart fifteen feet high; the huts inside were neat and clean. In the ditch or moat beside the wall, which was once easily filled with water from the streams that flow through the plain, crops of barley and maize were peacefully growing. Four miles from the sea, and close under the Great Wall, is the large walled city of Ninghae. It had not been visited by any Europeans during the past four years, and no missionary is resident there. The British officers visited this city, and met with no incivility. It is a town of wide open streets, with much trade and bustle; horses and mules seemed to be abundant, and the neighboring country is well cultivated. Further inland, the Great Wall begins to ascend the mountains. Our countrymen walked on the wall, rising to an elevation of 1,200 feet, which commanded a wide view. On their return to the fort, the mandarin commanded them with refreshing cups of tea. Their arrival, however, seemed to have occasioned some commotion at Ninghae; there was a coming and going, to and fro, of several Chinese officials, with Tartar cavalry escorts. The fort and the camp made a great display of silk flags, either to do honor to the foreigners, or, as they were told by a

it looks best at a distance, from St. Catherine's Hill, across the river Itchen. The transepts, however, projecting from each side far beyond the nave, have a bold and striking effect; and it is well set off by the grass and trees of the Cathedral precinct. The Cathedral is 520 feet in length, which is longer than any other in England, except those of Ely and Canterbury; and 390 feet of interior length is seen from the west entrance to the end of the choir. Much of the Norman work still remains behind the Perpendicular Gothic, or combined with it, in the nave and aisles. Bishop William of Wykeham's chantry, which contains his monumental effigy, is one of several beautiful chapels and recesses. Bishops Beaufort and Waynflete are similarly commemorated. The tomb of William Rufus, in the presbytery, and other monuments of historical interest, demand the visitor's notice. Not the least interesting to many a literary student or contemplative angler, is the tomb of Isaac Walton. He died in 1688, at the house of his son-in-law, Dr. Hawkins, who was Prebendary of Winchester.—*Illus. London News.*

MERCURY INTENSIFIERS.*

By COSMO I. BURTON and ARTHUR P. LAURIE.

DURING last season we read a paper before this society on "A New Mercury Intensifier," which also contained a scientific explanation of the action of the one commonly used. Since then we have made a few experiments, and inquired a little into the subject of mercury intensifiers. We were rather afraid to bring up this subject again, as it occurred to us that though we had not tried our intensifier in practice, it did not follow that others had not, and that we might be bringing down on our devoted heads a storm of adverse criticism.

Mr. Henderson, of London, has recently proposed using lime instead of ammonia after bleaching the negative with mercuric chloride.

Slaked lime is slightly soluble in water, forming the solution known as lime water. We bleached a negative in the usual way, and then put it in lime water. It darkened very slowly. Another piece of the same negative we covered with a paste of lime and water. This acted more rapidly, and the result was exactly the same in both cases—a rather dirty yellowish-brown negative. This process may be useful

the ordinary chloride of mercury and ammonia process, or by the method we described in our last paper.

And now, as this is all we have to say for the present about mercury intensifiers, perhaps we may be allowed to go beyond the title of this paper, and say a few words on the silver intensifier. It has lately been proposed to use for gelatine negatives the ordinary silver intensifier commonly used for collodion. On this subject we received the following information:

"If a gelatine negative is soaked in alum and hydrochloric acid,

Saturated solution of alum 1 pint,

Hydrochloric acid 1 ounce,

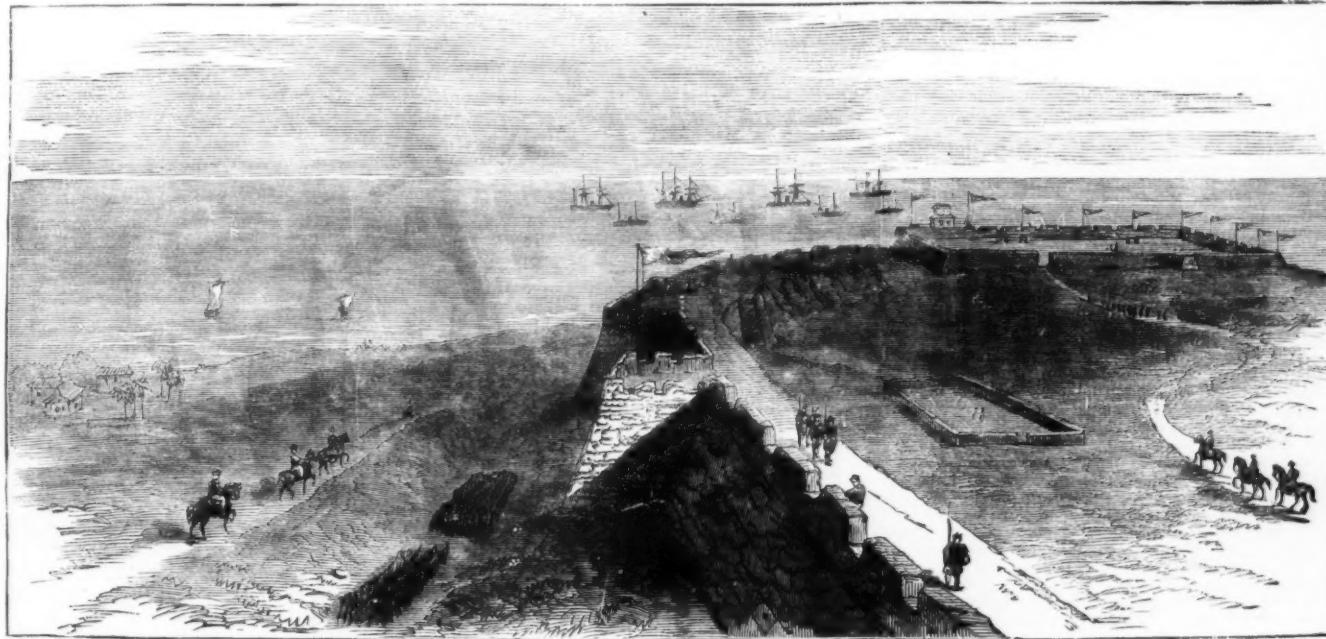
it may be intensified, like a wet plate, with either pyrogallic acid and silver, or iron and silver. Use a little more acid than for a wet plate. No red fog should appear, but should it appear it will redissolve in acid alum."

The explanation of this action, of course, is that a solution of pyrogallic and nitrate of silver is very unstable, and ready to deposit silver if it gets the slightest opportunity. When, therefore, it comes in contact with the metallic silver of the image, it begins to deposit silver there, while on the clear parts of the negative it has no action; but on attempting to apply this process directly to a gelatine negative, dense red fog is immediately produced. But if the negative is first treated with hydrochloric acid and alum, or with hydrochloric acid alone, the intensifier acts very well; red fog appears, however, if the process is forced too far, but can be got rid of by again putting the plate in the alum bath. If hydrochloric acid alone is used, it has a slight tendency to frill, which is prevented by the addition of alum.

Our directions to those who wish to use this process are, then, as follows:

Soak the negative for about five minutes in a bath consisting of one pint of a saturated solution of alum and one ounce of hydrochloric acid, wash with water, and then intensify exactly as you would a collodion negative. If red fog appears, again place your negative in the alum bath until the red color is gone; this may sometimes take as much as two or three hours.

And now, it may be asked, as has been done many times



THE GREAT WALL OF CHINA.

Chinese, "to make them frightened." The squadron left its anchorage next day.

The Great Wall was built two hundred and fifteen years B.C. as a defense of the northern frontier against the Tartars. From the coast it runs northeasterly for the astonishing distance of about 1,500 miles. Portions of it are of granite, and there are frequent towers forty feet high.—*Illustrated London News.*

WINCHESTER CATHEDRAL.

WESSEX, the West Saxon Kingdom, was converted to Christianity by Birinus, an emissary of Pope Honorius, in 635, but partly by the influence of King Oswald of Northumbria, who married the daughter of the King of Wessex. The bishopric was at first seated at Dorchester, not the county town of Dorsetshire, but a place of that name in Oxfordshire; it was removed to Winchester some forty or fifty years later. Another see was established at Sherborne, which was afterwards transferred to Crediton and Exeter. A Benedictine monastery was founded at Winchester along with the episcopal see. Archbishop Stigand, of Canterbury, who was ordered to crown William the Conqueror King of England, was also Bishop of Winchester. He was succeeded here by Bishop Walkelin, who began to build the Norman Cathedral in 1007, and the crypt and transepts of his building yet remain. It was consecrated in 1093, and received considerable additions in the early English style, a hundred years later, as seen in the eastern aisles and chapels. The Gothic nave was begun in 1345, and was continued by Bishop William of Wykeham, from 1366 to 1404; Cardinal William of Beaufort, from 1447; and Bishop William of Waynflete, from the last-mentioned date to 1486; three of the greatest prelates of the Plantagenet reigns, and founders, respectively, of Winchester College, with New College, Oxford; of the Hospital of St. Cross, at Winchester; and of Magdalen College, Oxford. The presbytery of the cathedral is the work of Bishop Fox, from 1500 to 1528, founder also of Corpus Christi, Oxford.

The exterior view of Winchester Cathedral, as shown in Mr. Read's drawing, has not the elegance and sublimity of some other ecclesiastical edifices in England. Its mass seems enormous, and so does its length, but the central tower is low, and heavy in aspect, and there is a want of decoration;

in practice, as the lime produces a deposit of very different appearance from that produced by ammonia, and the possibility of varying the results is always useful. Caustic potash will act in place of ammonia, but is rather too corrosive a substance to be used with safety. There is one important point to be remembered in using lime—its action is entirely different from that of ammonia. Ammonia combines with the mercurous chloride to form dimercurous-ammonium chloride, the black substance which darkens the negative. The action of lime is much simpler; it removes the chlorine from the chloride of mercury, forming chloride of calcium, and leaving in negative black oxide of mercury. Now the following statement occurs in several chemistry books: "Black oxide of mercury is decomposed by light into metallic mercury and the red oxide." This intensifier, therefore, must be used with caution, and its permanency carefully tested. With reference to the intensifier which we described in our last paper, we have not much more to say, except that bromide of mercury is rather more soluble in alcohol than in water, so we tried a solution in alcohol, and found it bleached the negative somewhat more rapidly than the water solution. We also made a few experiments with a view to using pyrogallic instead of the ferrous oxalate we formerly advised. Pyrogallic and ammonia will not do, so we tried caustic potash in place of ammonia, and it acted very decidedly; in fact, caustic potash alone will act, though of course in a different way. But its action is too violent, generally removing the film from the plate, and, if strong, dissolving it completely. We also tried lime water and pyrogallic; this acts fairly well. On adding the pyrogallic to the lime water, a beautiful violet color is produced, which disappears in a few seconds. Baryta water is better than lime water, because barium hydrate is more soluble than calcium hydrate; it can easily be procured from any chemist. Pyrogallic by itself has hardly any action.

On trying our intensifier on a collodion negative, we got rather curious results; immediately on immersing the negative in the solution of chloride or bromide of mercury, the image, which, to begin with, is light gray, becomes nearly black, and is made considerably more dense. On remaining in the solution for some time the image bleaches in the same way as a gelatine negative, and may be intensified either by

before. What is red fog? Why should the treatment of the negative with hydrochloric acid prevent its formation? Is there any connection between it and the green fog so common in gelatine negatives? These are rather difficult questions to answer, but we have already made some attempts to solve them, and if we should succeed, perhaps we may have the honor of bringing our explanation before this society.—*Photo. News.*

PISTACHIA GUM.

THIS new gum, which is soluble in oil, turpentine, and alcohol, is of a light yellowish color, and has an agreeable odor of mastic.

If the Pistachia gum is mixed with common resin, soda of a strength of twenty-five degrees has no soluble action on the gum, and soda of a strength even far greater than twenty-five degrees, has, no more than water, any effect on the unadulterated Pistachia gum. These facts alone are a sufficient proof of the value of this gum for the uses to which I have subjected it in my experiments.

It is well known that most of the gums or resins now used in the manufacture of varnish are soluble in soda, and therefore yield to the action of soap in a short space of time. Now, the varnish made with Pistachia gum possesses many advantages over the ordinary varnish, for besides being waterproof, it does not in any way tend to either the action of soap or soda, and it can also be advantageously used for oilcloth.

I found, after further experiment, that when left in contact with the open air, this new varnish thickens very quickly, which renders it a valuable acquisition to painters on glass and porcelain, both as a substitute for the burning process, or to mix with the colors now used.

The color of this varnish can be made of different shades, varying from a light gray to a beautiful dark brown, and it has the same appearance as the ordinary varnish. Pistachia gum, while of a similar character and of the same basis as Venetian turpentine, is far more important in its composition, which ought to render it valuable for commercial and medicinal purposes, and I may add, in conclusion, that *Pistacia terebinthus* gum, as a varnish and paint, in my opinion, will become in the future of great value for these purposes.—*Jules Greth.*

* Read before the Edinburgh Photographic Society.

KNOTS AND SPLICES.

See Engraving on first page.

1. Turn used in making up ropes.
2. End tapered for the purpose of passing it readily through a loop. To make this, we unlay the rope for the necessary length, reducing a rope diminishing in diameter toward the end, which is finished by interlacing the ends without cutting them, as it would weaken the work; it is lastly "whipped" with small twine.

3. Tapered end, covered with interlaced cordage for the purpose of making it stronger. This is done with very small twine attached at one end to the small eye, and at the other to the strands of the rope, thus making a strong "webbing" around the end.

4. Double turn used for making rope.

5. Eye splice. The strands of the cable are brought back over themselves, and interlaced with their original turns, as in a splice.

6. Tie for the end of a four-strand rope.

7. The same completed; the strands are tied together, forming loops, laying one over the other.

8. Commencement for making the end by interlacing the strands.

9. Interlacing complete, but not fastened.

10 and 11. Shell in two views used in No. 65, showing the disposition of it at the throat. This joining is advantageous, as it does not strain the cords, and it prevents them from cutting each other; so that the rings pass one into the other, and are joined outside the intermediate shell.

12. Interlacing in two directions.

13. Mode of finishing the end by several turns of the twine continued over the cable.

14. Interlacing commenced, in one direction.

15. Interlacing finished, the ends being worked under the strands, as in a splice.

16. Pigtail commenced.

17. Interlacing fastened.

18. Pigtail with the strands taut.

19. Dead-eye, shown in two views.

20. Pigtail finished. We pass the ends of the strands, one under the other, in the same way as if we were making a pudding splice; thus bringing it in a line with the rope, to which it is seized fast, and the ends cut off.

21. Scull pigtail; instead of holding the ends by a tie, we interlace them again, as in No. 16, the one under the other.

22. Pigtail, or "lark's nest." We make this to the "penant" of a cable, which has several strands, by taking the requisite number of turns over the penant, in such a manner that the strands shall lie under each other. This "pigtail" forms a knot at the end of the rope. It thus draws together two ropes, as shown in No. 32, forming a "shroud" knot. In these two pigtails, the strands are crossed before finishing the ends, so that the button, *a*, is made with the strands, *a* and *b*, with those of the rope, *b*.

23. Slip clinch to sailor's knot.

24. Slip clinch, secured.

25. Ordinary knot upon a double rope.

26. Bowline knot for a man to sit in at his work.

27. Called a "short splice," as it is not of great length, and, besides, can be made quickly.

28. Slip clinch.

29. Splice, as described in No. 33.

30. Long splice. This extends from *a* to *b*. We unlay the strands of each of the ropes we intend to join, for about half the length that the splice will be, putting each strand of the one between two strands of the other.

31. Simple fastening on a rope.

32. A "shroud" knot.

33. The ends of the rope are prepared for making the splice (No. 29) in the same manner as for the "shroud" knot in No. 32. When the strands are untwisted, we put the ends of two cords together as close as possible, and place the ends of the one between the strands of the other, above and below alternately, so as to interlace them as in No. 29. This splice is not, however, very strong, and is only used when there is no time to make a long splice, which is much the best.

34 and 35. Marline-spikes. Tools made of wood or iron, used to open out a rope to pass the strands of another through it.

36. Shows strands arranged as described in No. 30.

37. Fastening when a lever is used, and is employed when hauling upon large ropes, where the strength of several men are necessary.

38. A "pudding splice." This is commenced, like the others, by placing the rope end to end, the turns of the one being passed between those of the other; having first swelled out the yarns by a "rat's-tail," we put them, two by two, one over the other, twisting them tightly, and opening a way for them with the marline-spike. The inconvenience of this splice is, that it is larger in diameter than the rope itself; but when made sufficiently long, by gradually reducing the size of the strands, it has great strength.

39. This shows two strands, *a* and *b*, of the ropes, *A*, *B*, knotted together, being drawn as tight as possible; we unlay the strand, *a'*, of the rope, *A*, for half the length of the splice, and twist the strand, *b'*, of the rope, *B*, strongly in its place, tying *a'* and *b'* together tightly. The same process is again gone through on the rope, *B*, the strand, *a'*, of the rope, *A*, being knotted to the strand, *b'*, of the rope, *B*. When all the strands are thus knotted together, we interlace them with the strands of the cable. Thus the strands, *a* and *a'*, are interlocked by being passed alternately above and below the turns of the cord, *B*, the ends being also sometimes "whipped." In the same manner the strands, *b* and *b'*, pass alternately over and under the strands of the rope, *A*, and are in like manner "whipped." It is important that the several interlacings and knots should not meet at one point; we reduce the size of the strands toward the end, so that they lose themselves in the body of the splice, cutting off such parts as may project. This splice is employed for joining the ends of a rope when a chafed part has been cut out, and is quite as strong as the rope itself.

40. Belaying-pin opened to serve as a button; these are used where it is necessary to stop or check velocity.

41. Chain knot, or fastening.

42. Variable or regulating lashing. By laying the piece, *a*, horizontally, it can be slipped along the rope, *b*; by raising or lowering this, we shall raise or depress the weight, *c*, the cord, *b*, running over the two pulleys, *d*, from the piece, *a*, in the direction shown in the figure. The friction of the cord, *b*, passing through the hole, *e*, sufficiently fixes the piece, *a*, and holds the weight, *c*, securely.

43. Cleat, with three ties.

44. Cleat, showing the mode of belaying the cord.

45. The piece, *a*, of No. 42.

46. Fair leader.

47. Cleat to be fixed to a stay.

48. Loop for slipping other lines.

49. A "bend" which is only used for fear of the stoppers snapping.

50. Bastard loop, made on the end of the rope, and whipped with yarns.

51. Tie to pins: *a*, the pin; *b*, small cords fixed by a cross tie.

52. Cleat, fixed to the "rail," either with screws or nails, to which the lines are belayed.

53. Waterman's knot.

54. Fair leader.

55. Tie, or bend to pier.

56. Simple fastening to pier.

57. Fastening by a loop. This can be tied or untied without loosening the loop itself. It is made by following, toward the longer loop, the direction as numbered 1, 2, 3, 4, 5, and is terminated by the loop, 6, 7, 8, finally passing it over the head of the post, *A*. This knot holds itself, the turns of the cable sufficiently to again pass the loop, 6, 7, 8 over the post, *A*, and turn the ends in the contrary direction to that in which they were made (as 5, 4, 3, 2, 1).

58. Iron "shell," in two views.

59 and 60 "Wedding" knots; *a*, *b*, eyelets; *c*, *d*, the join; *e*, the fastening.

61. Lark's-head fastening to running knot.

62. A round turn; the cord, *a*, is passed through the bight of the cord, *b*, over the button, *c*, where it is secured by an ordinary knot.63. Belaying-pin splice. The cord, *b*, "stops" the pin, *a*, its end being spliced upon itself, and "served" with yarn; this rope, with its pin, is passed through the spliced eye, *f*, of the line, *g*.

64. Round button.

65. Joint by a spherical shell, each loop, *a* and *b*, being made by ties and splices, and surrounding the shell, *c*.

66. Belaying-pin, shown separately, before being stoppered.

67. Fastening to shears.

68. Square mooring. When the cable is round the post, *A*, and the piece, *c*, without being crossed, it lies in the section 1, 2, 3, 4, 5, 6, 7, and the end is fastened by tying.

69. Wooden shell in section.

each other; the crossing of the two legs gives a means of securing the knot.

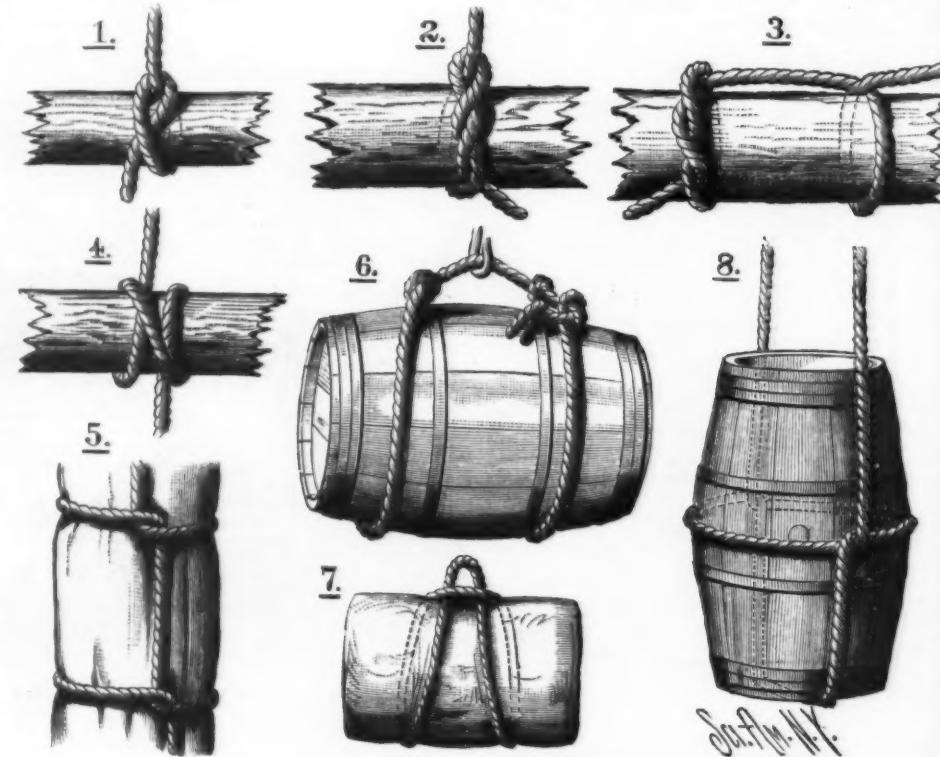
14'. For binding timbers; *a*, knot commenced. Take several turns round the timbers and fasten the ends by passing them under the turns; *b*, knot completed. The end of a round stick, *m*, termed a packing stick, should be passed under the knot, the cord being slack enough to allow of this. By turning the stick, the turns can be tightened to any extent; when tight, we fasten the longer arm of the lever to some fixed point, by a rope, *p*, *q*, so that it cannot fly back. Care must be taken not to turn the stick too far, or the rope may be broken. As the timber dries and shrinks, the lever may be used to make all taut again.

LIFTING TACKLE.

EVERY engineer, builder, and millwright knows the great importance that is attached to lifting heavy weights and fixing materials and machinery. It is no use for work to be properly finished if accidents happen in fixing. The young and inexperienced erector is frequently at a loss to know how and where to attach his ropes and other appliances to secure the best result, and, worst of all, no effort is made to teach him; he must rely entirely on his own observations. So well known is this ignorance with respect to lifting and hoisting in mechanical trades, that it is frequently stated, and often acted upon, that an old sailor makes the best erector. He is as nimble as a monkey on a pole or scaffold. We know very well that in our younger days we experienced considerable difficulty in obtaining information respecting knots, loops, and other rope fastenings.

No doubt all who have to do with the moving of machinery and other heavy masses will find the rope knots and fastenings shown in the engraving very useful. The information is not only useful when away from home in foreign countries, or away from the workshop, but it is useful in the workshop. The man who understands the use of rope tackle is a king among his fellows.

We have often thought that in these days of steam cranes and hydraulic jacks, men are not so ready in resources as



LIFTING TACKLE.

Figs. 1, Half Hitch. 2, Timber Hitch. 3, Half Hitch and Timber Hitch. 4, Clove Hitch. 5, Hammock Hitch. 6, Cask Sling. 7, Bale. 8, Butt Sling on End.

70. Crossed fastening. The turns of the cable, passing in front of the post, *B*, are crossed at the back of *C*, in the direction 1, 2, 3, 4, 5, 6, 7, 8, the end, 8, being secured to the cable.

71. Wooden shell.

72. Double-chain fastening.

73. Lashing for "ram" block, or "dead-eye." The ram blocks, *a* and *b*, are strapped by the cords, *c*, which hold them; the small lanyards, *d*, pass through the holes to make the connection, and as they are tightened give the requisite tension to the cordage; the ends are fastened to the main rope. Usually one of these dead-eyes is held by an iron strap to the point where it is required to fix and strain the cordage, which is ordinarily a shroud.

74. Chain fastening.

75. Simple band, showing the upper side.

76. The same, showing the under side and the knot.

77. Tie, with crossed ends, commenced; a turn is taken under the strands, to hold the ends of the cord.

78. The same, completed.

79. Bend with crossed strands, commenced, the one end being looped over the other.

80. The same, completed.

81. Necklace tie, seen on the upper side.

82. The same, seen underneath. The greater the strain on the cords, the tighter the knot becomes.

83 and 84 are similar splices to 7 and 8 with slight modifications.

85 shows the commencement of 18'; the legs in elevation; 12' being a front view. An ordinary band, made by several turns of a small rope, is lapped round them and hauled taut, and then interlaced at the ends. This done, the legs are shifted into the shape of a St. Andrew's cross. Thus the lashing is tightened, and, for further security, we pass the line several times over the tie and between the spars, knotting the ends.

86. Portuguese knot. This is a lashing for shear legs, and must be tight enough to prevent the spars slipping on

they were many years ago. They trust too much to machinery and too little to themselves. They seem afraid to exert their real strength at the end of a rope. If we can only induce a few of our readers to study the art of lifting weights and encourage confidence in manual strength, we shall not consider our efforts to have been in vain. The various kinds of knots and loops are shown in the annexed engravings, and on our front page.

DETECTION OF GOLD.

A WRITER in the *American Naturalist* says that there is a simple method for the detection of gold in quartz, pyrite, etc., which is not generally described in the mineralogical text-books. It is an adaptation of the well-known amalgamation process, and serves to detect very minute traces of the precious metal.

Place the finely-powdered and roasted mineral in a test-tube, add water and a single drop of mercury; close the test-tube with the thumb and shake thoroughly and for some time. Decant the water, add more and decant repeatedly, thus washing the drop of mercury until it is perfectly clear. The drop of mercury now contains any gold that may have been present. It is then placed in a small porcelain capsule and heated until the mercury is volatilized and the residue of gold is left in the bottom of the capsule. This residue may be tested either by dissolving in aqua regia and obtaining the purple of Cassius with protochloride of tin, or by taking up with a fragment of moist filter paper, and then fusing to a globule on charcoal in the blow-pipe flame.

It is being shown that gold is much more universally distributed than was formerly supposed. It has recently been found in Fulton and Saratoga Counties, New York, where it occurs in pyrite; and it has also been discovered in the gravel of Chester Creek, at Lenni, Delaware County, Pa. In one of the Virginia gold mines wonderful richness is reported—\$160,000 worth of pure gold having been taken from a space of three square feet.

RESISTANCE OF GRAPE-VINES TO PHYLLOXERA
IN SANDY SOIL.

The immunity from the attacks of phylloxera enjoyed by grape-vines when planted in sandy soil has long been known, and has been attributed to various causes. M. Saint-André, of Montpellier, France, discusses this subject in the *Message Agricole* for May 10, 1881, and believes that neither the mobility nor the angularity of the particles of sand, nor the absence of cavities, nor the chemical composition of sandy soil, is a sufficient reason. Nor is the presence of a subterranean current of water in sandy soil an admissible reason, since it has been proven that the quantity of water contained in such soils at different depths and at different seasons is always smaller than that contained at the same period in other soils where the presence of phylloxera renders the culture of the grape-vine impossible. He believes, however, that the circulation of water in the soil is a matter of the first importance in regard to the presence of phylloxera, and that there exists a close relation between the resisting power of the vines and the capillary capacity of the soil. By this latter term he means the quantity of water which can be mechanically retained by a soil completely saturated with it. When this capillary capacity of the soil is very small, the grape-vine enjoys absolute immunity from phylloxera attacks; the more it increases the more the plants suffer. Sandy soil was found to possess the smallest capillary capacity, varying from 23 to 35 per cent, and in such soil the grape-vines are not only never attacked by phylloxera, but the insect even disappears from infested plants when these are transplanted to such soils. Where the capillary capacity is above 40 per cent, the vineyards in France are rapidly disappearing under the attack of the insect. Between the two limits above given, the plants suffer more or less. Exact figures cannot be given, as much depends on the resisting powers of the different varieties of grape-vines and on the mode of cultivation. American resisting vines can be successfully cultivated in soils the capillary capacity of which attains and even surpasses 43 per cent. Whether the diminished capillary capacity has a direct influence on the vitality of the phylloxera, or whether through it the roots of the plant are enabled to resist the attack of the insect, is at present undecided.

While there is some plausibility in the theory advanced by M. Saint-André, we believe there are sufficient reasons to account for the diminished virulence of phylloxera in sandy soil in its mechanical action upon the insect. Our own experiments with both phylloxera and many other insects in sand, prove conclusively that it is more difficult for such small, soft-bodied insects to make headway or to exist in sandy soil, not only because of the mechanical action of the particles adhering to all parts of the body, but because of the mobility of these particles and the absence of cracks, interstices, and galleries which are formed in loamy or clayey soil, either by the penetration of roots, the effects of contraction during drought, or the action of the insects themselves.—*C. V. Riley, in Farmer's Review.*

THE CULTIVATION OF THE RAMIE PLANT.

The ramie plant possesses qualities and merits of the highest value for textile industries, and in the whole of Europe, Consul Stanton states, France alone has attempted the industrial development of this Chinese plant, and the attempt has met with such success as to give that country a decided advantage over other European manufacturing countries. At the present time the cultivation makes great progress in Southern France, Corsica, and Algiers, and a practical process has lately been discovered for separating the fibers from the stems. The plant belongs to the nettle family, and although stinging, is similar to the stinging nettle in the form both of its leaves and branches, having, however, a much more luxuriant growth. The branches grow straight and in bunches, and are composed of a brittle woody substance, filled with pith, and surrounded with a fibrous covering which, in its turn, is covered with a thin skin or rind. The fibers are bound together by a resinous substance, which is more difficult to dissolve than that contained in flax and hemp, and from this circumstance the setting the ramie plant is more laborious than hemp and flax, though the hacking of the stems is less arduous. The propagation of the plant may be effected by seeds, layers, or cuttings; but as the reproduction from seeds is generally slow and uncertain, slips and layers are more often used. The ramie is perennial, and not like flax and hemp, an annual, and its strength and fertility increase with its age; it withstands both drought and damp, but is very susceptible to frost. Even after frost, however, it is only the first crop that is lost, since the roots, which penetrate the ground to a depth of about a foot, are seldom affected, and soon put forth new shoots. Its growth is unusually rapid, and even in France it attains annually a height of from six to eight feet. In its home, however (China and Bengal), it attains the height of fifteen feet. By cutting the stems when they have attained a height of three feet, several crops and finer fibers are obtained, the plant renewing its shoots continually. The leaves, when dried, are valuable for the manufacture of the tough paper which is so extensively used in China, while the green ones afford excellent cattle fodder. On account of its luxuriant growth, extensive manuring is requisite; and, with the exception of this manuring, and the careful manner in which it must be done, the cultivation of the ramie is of the simplest kind, and with due care for frost, it may be planted at any season. The planting is generally in furrow, ten inches deep, and a yard apart, the plants being set out at intervals of a yard. Hoeing and digging are only necessary the first year, the plant growing afterwards with such luxuriance as to smother all weeds. In the spring, and after each cutting, hoeing is generally resorted to; and if, at the approach of winter, the earth is heaped up round the roots, to protect them from frost, the branches increase rapidly in number, the first growth yielding from three to four, the second from six to eight, the third from ten to twelve, and the fourth (this, however, is only in warm climates), from sixteen to twenty branches. The pecuniary results so far obtained are most satisfactory. It is maintained that the ramie plant will yield a crop worth from £56 to £80 per hectare (2.47 acres); and assuming three cuttings are annually obtained, there would be a yield of from 4,000 to 5,000 kilos of leaves alone, which would cover all the expenses of cultivation. In addition to this, there would be from 1,500 to 2,200 kilos of fiber, from which 1,200 to 1,500 kilos of white linen could be spun. The tenacity of the ramie fiber is 30 per cent greater than that of flax, and in consequence of this tenacity, it has for many years been used in China in the manufacture of many articles, in which solidity is absolutely necessary. In China from fibers of this plant the coarsest

nets are woven, and fabrics which surpass in gloss and delicacy the finest batiste. As with flax and hemp, the first operation is to separate the fibers from the resinous substance which unites them; this is effected by steeping in water. The Belgians have recently substituted for the old plan, a new, more rapid, and healthier process, which produces an excellent commercial result. Large square cemented vats are used; in these the branches are laid, for one or two days, and for ramie five to six days; to the water one-half per cent of the weight of the branches, of pulverized charcoal is added, and the same quantity of carbonate of soda or potash, and throughout the process the vats are kept carefully closed. In this manner decomposition takes place slowly, and the fibers are protected from the injurious effects of the exhalations of sulphured hydrogen. After the glutin is dissolved from the fibers, they have only to be separated from the woody tissue; this is effected by hacking, which was formerly slowly and ardently done by hand, but is now performed by machinery in a very simple manner. The branches are passed successively through four pairs of rollers, which destroy the woody tissue; then the hacking is done by two pairs of grooved cylinders, which, by a movement backward and forward rub and cleanse the fibers from all impurities; a third machine, which consists of a hollow cylinder inclosing an axle does the combing. This axle is provided with a number of whips, which beat the fibers continually; the fibers enter the cylinder at an opening in the side, the dust is removed by a ventilator, and the branches, reduced to the finest fibers, leave the machine perfectly cleansed, and after bleaching are ready for spinning. In consequence of the silky character of the fiber, it is necessary to fasten the warp securely to prevent its being pulled out when weaving. Special attention is also paid to the dyeing, to insure fast colors. In France, measures have been taken for the manufacture of elegant ramie stuffs on a large scale, either from ramie for table cloths and furniture coverings, or mixed with wool and silk for draperies, and it is the opinion of those engaged in the manufacture of textile fabrics that the time has arrived when this material will play a great role in textile industries.—*Jour. Soc. Arts.*

MEISO.

By PROF. D. P. PENHALLOW, late of the Imperial Agricultural College of Japan.

It is well known that the Japanese are a rice-eating people, with whom this article, meiso, is perhaps, the most important of all their foods, but it is not so generally known that the flesh of animals could hardly be considered a regular article of food until within the past few years, and even now, with the great mass of the people, meat is seldom used. Thus for centuries, these people have lived almost wholly without that which western people consider so important a source of nitrogen. It seems, however, that the demands of nature were recognized and met by obtaining from the vegetable kingdom what they failed to secure from the animal, and thus it is we find them consuming enormous quantities of beans prepared in a great variety of ways. Some of the important preparations from beans are cheese, or tofu—a white, curdy mass strongly resembling cottage cheese, unflavored with salt, and held in high estimation. It is prepared in a variety of ways, but almost invariably forms a part of every meal as a constituent of soup. Cake—a stiff, jelly-like confection made by straining boiled beans and incorporating with a large proportion of sugar. Pickles—beans in the pod and frequently on the stem, pickled in a strong brine; they are eaten without further preparation. Sugared beans—roasted beans enveloped in a heavy coating of sugar, and sold as a confection. Shoyu, or Soy—a liquid of dark color and salty flavor, made by fermenting a mixture of salt, beans, and roasted wheat or barley. It is largely eaten with fish and rice. There are other modes of preparation which we will pass over with the exception of meiso, which forms the subject of this article.

The pasty mass manufactured and sold under this name constitutes one of the most important of the preparations from beans, and enters largely into the diet of all classes as a basis for soup, or, in various forms, as a sauce for fish and meat. In composition it consists of

Salt	4.5 to = 2.00 bushels.
White beans.....	1 koku=5.13 "
Rice.....	4 to = 2.05 "

SALT.—The salt employed is of a very crude sort. It is obtained from sea water by evaporation under the influence of solar heat, and as no attempts are made to secure any special degree of purity, it is consequently contaminated with other salts and its specific value thereby lessened. Sticks, straw—especially from the coarse bags in which it is transported—and dirt are also always to be found, and as no efforts to cleanse or purify, beyond removal of the larger fragments of straw, etc., are made at the factory, the product into which such salt enters has a rather uninviting appearance. It is always used dry.

BEANS.—The ordinary white beans appear to be used in preference to any others. They are prepared by boiling for about six hours, when the fire is drawn and they are allowed to cool in the boiler. The next morning they are removed from the boiler and placed in mash boxes which measure 10x8x1 feet, where they are thoroughly reduced and mixed with the rice and salt by means of a round pole used as a pestle.

RICE.—White rice, or that which has been well cleaned, is soaked in cold water for two days. It is then well drained and transferred to a boiler containing fresh water, when it is steamed for three hours. While yet hot, it is taken to a warm room and allowed to remain under the influence of a warm, moist air for four days, when the whole is found to be covered with an abundant growth of fungus.

The room in which this operation is performed usually measures about 10x20 feet, is constructed of mud walls—eight or ten inches in thickness, and is made as close as possible with the exception of one small window to admit light for the workmen, and a door through which to enter. The only moisture in the room is that which comes from the moist rice, but a constant temperature of 80° F. is maintained by means of a large charcoal fire at each end of the room. It is regarded that a warm, moist air, undisturbed by draughts, is quite essential to the success of the operation, though darkness is not deemed requisite, the absence of windows being more a matter of economy than anything else. The production of the fungus is usually regarded as the critical part of the whole manufacture, and failure sometimes occurs. No reason could be obtained from the Japanese why the subsequent fermentation is dependent upon the pre-

sence of the fungus; that its production is an essential part of the process was all the information that could be obtained.

At the end of four days, the rice is taken out into a large airy room and spread upon straw mats, 3x6 feet, and allowed to cool for one and a half hours. It is then transferred to small trays which measure 18x8x1½ inches, for convenience in handling, when it is allowed to cool as rapidly as it can. Whether the rice now dries or remains moist appears to be a matter of indifference. As soon as thoroughly cooled, it is incorporated with the salt and beans. It is generally customary, however, to prepare the rice in large quantities once in four days, and thus have a stock always on hand. In that case, as soon as cooled, it is mixed with the salt and placed in large storage vats, where it is tamped solid by the feet, and will then keep without trouble for two months.

When all the ingredients have been thus prepared, they are placed, cold, in the mixing boxes already described, and thoroughly incorporated into a stiff, pasty mass by means of a long mixing rod. This mixture is then placed in large vats having a capacity of about seventeen koku or eighty-seven bushels. Here it is packed solid by the feet and allowed to undergo a very slow fermentation. Every effort is made to keep the temperature of the mass down as low as possible, and if, during the summer, the heat of fermentation gets too great, the whole mass spoils. It is then mixed with roasted wheat and by further fermentation converted into shoyu or soy. Sometimes the mixture fails to ferment properly, when it is taken out and mixed with a fresh portion of beans. The fermentation is allowed to continue six months in summer and eight months in winter, at the end of which time the meiso is ready for the market.

The result of these various operations is a stiff, pasty mixture of repulsive appearance and disagreeably sour odor, as though it would hardly find favor with Americans or Europeans, possibly excepting epicures, it seems to be in great demand with the Japanese.

The factory where these facts were obtained employs six men, and the annual produce amounts to from 900 to 1,000 koku, equal to 4,617 to 5,130 bushels. The cost of the various ingredients and the finished product is as follows:

Beans, 1 koku—5.13 bu.....	6 yen. †
Rice, 1 koku.....	10 "
Salt, 1 koku.....	5.40 "
Total cost of meiso per koku.....	7.13 "
Market price per koku.....	13.20 "

The mouldy rice, prepared as described, constitutes the yeast of the Japanese, and is used for all the purposes, including bread-making, for which we would employ ordinary yeast. Its production is, therefore, of considerable importance, as upon it depends the manufacture of meiso, saki (fermented liquor), vinegar, and shoyu. It, therefore, becomes evident that the principal interest of this entire manufacture centers in the fungus which develops upon the rice, because of the variety of forms which may be developed from its spores under different conditions of warmth and moisture, and also exposure to the air.

In order to obtain some satisfactory evidence on this interesting subject, the various products—mouldy rice, meiso, yeast, and vinegar—were submitted to microscopic examination. A sample of meiso was taken from a vat where fermentation had been in progress for some time. It was noticed that the temperature was so low that the whole mass felt cold to the hand, and thus whatever fermentation was in progress, must have been going on at a very slow rate. On examination, there appeared numerous spore-like bodies, similar in form and size to the spores from the mouldy rice, which they doubtless were. In addition, there were many short and irregularly branched filaments in all stages of growth from the spore. Nothing was seen which could be called yeast-plant proper or *S. cerevisiae*.

A sample of freshly made vinegar showed the liquid to contain a very large number of spermatin-like bodies, while masses of the true vinegar-plant were also numerous. The cells of these measured one seven-thousandth of an inch in diameter. No true yeast-plant was to be found, though this may possibly have been due to the degree of saccharine exhaustion as well as the low temperature of the fermentation. A sample of vinegar, containing a good surface growth of the vinegar-plant, was kept for three weeks, in the hope that fruit might appear and thus furnish one more link in the chain of evidence; but none appeared, although the net-work of cells constantly and rapidly increased, and further observations were interrupted by departure for home.

Yeast made in the ordinary way, but using the mouldy rice to start the ferment, showed the familiar forms of the true yeast-plant. The fungus on the mouldy rice proved to be our old friend *Penicillium*.

These observations furnish us with a practical illustration of the fact that these vegetable structures of low degree of organization, are not necessarily constant in form and structure, but are liable to vary greatly under different conditions of temperature, moisture, and exposure, and that they are associated with fermentation of varying rapidity as well as with products which are more or less dissimilar. They furnish one instance of the effect which environment has upon the individual.—*Kansas City Review*.

LYCOPODINE, THE FIRST ALKALOID OF THE VASCULAR CRYPTOGAMS.

By KARL BORDEKER.

The alkaloid in question is obtained from *Lycopodium complanatum*, known as being richer in alumina than any other plant. Its composition is expressed by the formula $C_{20}H_{30}N_2O_9$. It melts at 114° to 115°, dissolves easily in alcohol, chloroform, benzol, amylie alcohol, ether, and water. Its taste is bitter. The very dilute aqueous solution is rendered turbid, and colored brownish red by iodine water.

OIL ADULTERATION.

The manager of the Marseilles public laboratory gives the following methods for detecting adulteration in olive oil with other oils:

Beet root oil contains sulphur, and saponifying the oil with an alcoholic solution of caustic potash will bring out the sulphurous acid. Sesame oil can be found by adding a little muriatic acid to a small piece of sugar, and shaking these along with some of the oil—the sesame oil will be recognized by its red color. Cotton seed oil has to be treated with nitric acid, and, on shaking, a coffee-brown color will be seen.

* Prices for 1880; probably somewhat higher at present.

† Yen, gold, is equal to the U. S. dollar.

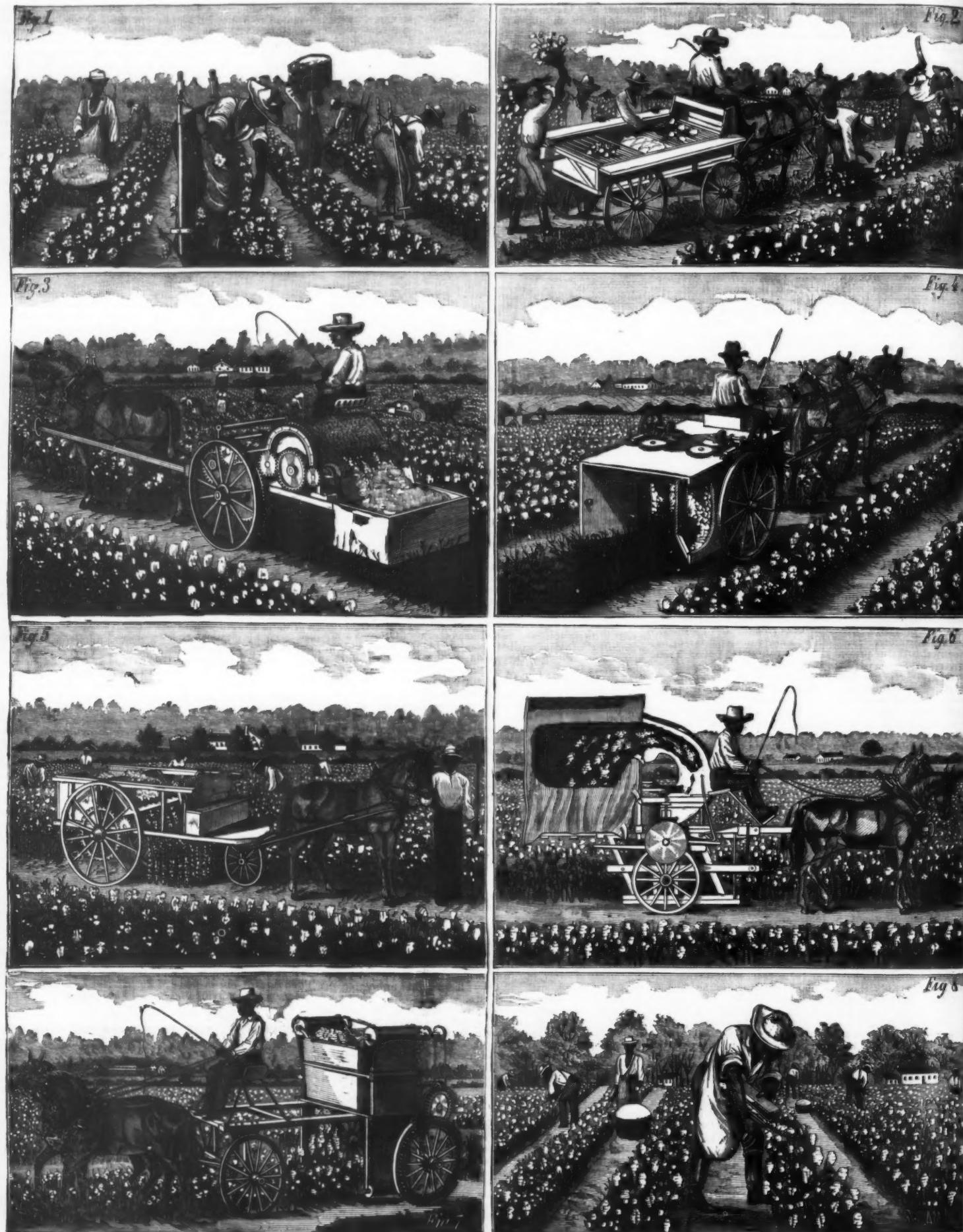
COTTON AND ITS FUTURE.—AN OPPORTUNITY FOR INVENTION.

An immediate effect of the International Exhibition, opened at Atlanta, Georgia, October 5, 1881, is likely to be a great increase of knowledge among capitalists touching the opportunities which the South affords for profitable investments. But of still greater value probably will be the lessons learned

enormous in quantity and in money value. The world is well aware of that. But not so many are aware that probably not a hundredth part of the productive capacity of the country has ever been developed.

For the past five years the cotton crop has averaged nearly five million bales, and last year it approached six million bales; yet not more than two or three acres in every hundred available for cotton have been under cultivation, and on the

with the imperfect tillage and incomplete picking of the crop now prevailing in the Yazoo bottom (between the Mississippi River and the Yazoo, in the State of Mississippi), the average product per acre is over three quarters of a bale. Estimating the lands reclaimable by simple exclusion of the Mississippi overflow at only 3,000,000 acres, the annual product could readily be raised to 2,250,000 bales, without any change in methods of culture, on the Yazoo bottom alone. With



MACHINES AND APPLIANCES FOR HARVESTING COTTON.

by Southern cultivators with respect to means and methods of increasing the productiveness of their fields and the money value of their crops. Until recently the agricultural processes and appliances of the Southern planters have not been remarkable for economy and efficiency; and even yet the liberal adoption of the modern labor-saving machinery is the exception rather than the rule in the South. It is true that in the aggregate the products of the Cotton States are

land cultivated the yield has not been half as much in quantity or anything near as valuable as it might have been. During the census year the cotton acreage was 14,441,993 acres; the yield was 5,737,207 bales, or an average of four bales (of 475 pounds) to ten acres. Under proper cultivation and handling a bale to the acre is common, and two bales to the acre not uncommon. In his preliminary report on the cotton crop, Special Census Agent Hilgard remarks that even

improved cultivation, he says, the production could easily be brought up to 5,000,000 bales, and thus with a similar improvement in the culture of the uplands, the State of Mississippi could easily produce the entire crop of the United States. He adds, in a foot note, that so far from overestimating the possibilities within reach of careful culture, this statement does not adequately represent them: Without any stipulation as to improved culture, Mr. Atkinson has

estimated that one-tenth of the cotton area of Texas might yield as much cotton as the entire South now produces.

There is no ground for fear that the cotton market can be permanently glutted, provided the cost of the increased product can be kept sufficiently low. Not one in the hundred of the population of the world has yet been reached by machine-made cottons, and the chief obstacle to the rest being made tributary to our cotton fields and cotton mills is a paltry fraction of a cent, perhaps, in the cost of a yard of cloth. The lowering of the cost of cotton to the cultivator, and the consequent extension of the area under profitable cultivation, can be brought about only by increasing the efficiency of the laborer and the productiveness of the soil. The first is being rapidly done by the introduction of improved cultivators, and the latter by the employment of fertilizers, by cleaner and more efficient methods of collecting and handling the



RECIPROCATING HAND COTTON PICKER.

fiber, by more thoroughly utilizing the hitherto waste products, and by the introduction of economical and effective remedies for the destructive cotton worm and similar pests; for example, by the use of pyrethrum solution, as recommended by Prof. Riley.

Perhaps the most promising field of effort—at any rate the one in which successful effort would yield the highest results—is in the development of some practicable and economical method of gathering the lint by machinery. A device which should do for cotton picking what Whitney's gin did for the work of freeing cotton lint from the seed, would give an incalculable impetus to the extension of cotton culture. The demand for such an invention is urgent, increasingly urgent. It is doubtful whether any phase of agricultural labor needs the aid of the inventor so badly, or promises so rich a return for successful effort. Already a crop amounting in value to three or four hundred million dollars is every year made difficult to secure, and subjected to serious hazard and no inconsiderable loss, through lack of efficient harvesting machinery; and any rapid increase in the crop is prevented by the lack of laborers at the critical season, laborers whose unattainable services might be dispensed with were it possible to relegate the work of gathering

of two wooden staffs having foot rests pivoted at the bottom and provided with adjustable slides near the top, which are connected with a waist belt worn by the picker. The slides are provided with a clamp connected with the waist belt, so that when the staffs are thrown outward by the pressure of the knees the clamps bind the staffs and support the waist belt at that point.

The cotton harvester shown in Fig. 2 consists of a wagon having a straight body open at the top, and provided with a number of transverse stretched wires, over which the stalks of the plants are struck in such a way as to loosen the cotton from the bolls, when it falls into the wagon box. This is the invention of Mr. D. C. Hubbard, of Point Coupee Parish, La.

The cotton harvester shown in Fig. 3 is provided with a large picker cylinder covered with a close surface of bristles, forming a complete bristles brush face extending the entire length of the cylinder. This picker cylinder is revolved by connection with one of the drive wheels as the machine is drawn along over the rows of cotton plants. The bristles seize the ripe cotton from the pod without drawing out the unripe cotton or injuring the cotton or plants.

The machine is provided with a reel in front which bends down the cotton plants toward the face of the brush. There is a cleaning cylinder behind that draws the cotton from the picker cylinder and deposits it in the box at the rear of the machine. All of the rotating parts receive their motion from one of the supporting wheels of the machine. This invention was patented in 1872, by Mr. O. P. Myers, of Canton, Ohio.

A machine, in some respects resembling that of Mr. Myers, is shown in Fig. 4. In this machine there are four vertical brushes, arranged in two pairs; one pair on each side of the row of cotton plants. These brushes remove the cotton from the bolls and carry it into the receptacles arranged on either side of the machine. The brushes revolve against combs arranged along the vertical edges of the openings in which the brushes revolve. This machine is the invention of Mr. Thomas P. Moores, of Milliken's Bend, La. It was patented in 1880.

The principle of the machine represented in Fig. 5 is quite different from those above described. In this picker, series of barbed flexible rods are pushed down into the cotton plants in alternation, each in its ascent removing the cotton from the bolls, being assisted by brushes arranged along the edges of the vibrating arms. The cotton is carried from the tops of the arms by endless bands and delivered to a receptacle at the rear of the machine. This picker was patented in 1877, by Mr. Orren R. Smith, of Raleigh, N. C.

The cotton harvester shown in Fig. 6 operates by air pressure, the necessary vacuum being created by a horizontal fan driven by the supporting wheel of the machine. A series of shells or curved hoops loosen the cotton from the bolls, the hoops being inclosed by a hood, from which the cotton is drawn by the fan, and discharged into the wire cloth receptacle at the rear of the machine, the cotton being retained while the air is allowed free escape through the meshes of the wire cloth. This machine was patented in 1877, by Mr. F. Van Dorn, of Basking Ridge, N. J.

In Fig. 7 we represent an electric cotton picker, patented by Mr. Robert F. Cooke, of Brooklyn, N. Y., in 1870. In this machine two endless rubber belts, arranged vertically on opposite sides of the machine, are excited electrically by friction, the cotton plant being agitated by a reel, or otherwise, when the ripe cotton, being disengaged from the bolls, is attracted by the electrified belt, by which it is carried upward. It is disengaged at the top, and falls into a receptacle placed between the two belts.

Fig. 8 shows a hand cotton picker, patented in 1867, by Mr. Joseph E. Carver, of Bridgewater, Mass. This invention consists in a reciprocating tongue provided with teeth and fitted to an oblong box carrying a sack at its rear end. The box is provided with an elastic plate having spines, and when the tongue is reciprocated by the handle it takes the cotton from the boll, and, by moving it forward by a succession of steps, carries it into the box, from which it finally drops into the sack.

In Figs. 9 and 10 is shown a hand cotton picker, which is remarkable for its simplicity and cheapness. It consists of gloves provided with wire hooks inclining backward toward the wrist, and a brush worn upon the waistband over the bag or other receptacle intended to receive the cotton.

The ripe cotton is readily removed from the bolls by means of the wire hooks, and it is removed from the hooks by passing them over the brush. Figure 10 is an enlarged

The hand picker shown in Figures 14, 15, and 16 consists of a rotating spindle, having a crank by means of which it may be turned. The spindle is moistened continuously, so that when thrust into a cotton boll the cotton will adhere and wind upon the spindle as the latter is revolved. When the spindle is full it is placed over a basket and a board—called by the inventor a "shedding board"—is moved outward along the four guide pins, and pushes off the boll of cotton.

In the engraving Fig. 14 is an end elevation, Fig. 15 is a plan view, and Fig. 16 is a face view, showing the shedding board with handles in the ends. This invention was patented in 1879, by Mr. T. W. Ham, of Frossa, Texas.

For those of our readers who may be interested in this problem, and yet unfamiliar with the conditions under which a mechanical cotton picker must be operated, a few words

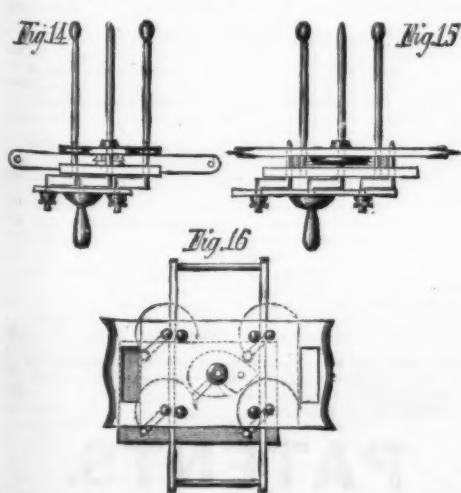


ENDLESS CHAIN COTTON PICKERS.

with reference to the growth of cotton and the manner of its cultivation may not be out of place.

As the high bush or "tree" cotton which produces the long staple "sea islands" cotton furnishes but a small part of the crop, we may assume that the picking machine will be primarily designed for the upland cotton fields. In these the cotton bush grows from two to four feet high, the more common height being under three feet. The branches spread like those of an apple tree in miniature, and the cotton bolls are distributed about the limbs somewhat as apples are on a sparsely bearing tree. The green bolls, which are an inch or so in diameter, expand and burst at maturity, exposing the snowy fiber for which the plant is cultivated, the bolls on the lower branches usually maturing first. The bolls are supported by foot stalks from two to four inches long, and for the most part grow near the outer ends of the limbs. A pull of about one ounce suffices to draw the lint from the ripe pods. In gathering the lint it is useful to keep it free from leaves, stems, or fragments of the shell of the pods, all of which goes by the name of "trash," and impairs the value of the fiber.

The plants are set in rows, from two to seven feet apart, according to the quality of the soil, and are thinned out in the rows so that the plants are from two to four feet apart. In the extreme south the bolls begin to burst as early as the first of July; further north, the picking begins a month or



REVOLVING SPINDLE.—HAND COTTON PICKER.

ing the cotton, in any considerable degree, to machinery.

As an illustration of what has already been accomplished in the direction of mechanical aids to cotton picking, we show on another page of this issue of the SUPPLEMENT a dozen or more patented devices for use in the cotton field. How far any of them meets the requirements of the case we are not prepared to say. That none of them is entirely satisfactory would appear probable from the single fact that cotton is still picked by unaided human fingers.

The appliance shown in Fig. 1 was patented by Mr. William J. Lynch, of Old Town, Ark., and is designed to assist the cotton picker in supporting his body while stooping in the act of picking cotton, thus relieving the legs of weight that would otherwise come upon them. This device consists

view of one of the fingers of the glove. This invention was patented in 1876, by Mr. R. A. Cutliff, of Shreveport, La.

A form of hand cotton picker, employing an endless chain carrying bars, is shown in Figures 11 and 12, Figure 12 being a detail view of the stripper. In this device the endless toothed chain is driven by a sprocket wheel, and in turn drives a pair of winged wheels or strippers which remove from the chain the cotton picked from the bolls by the teeth, and allow it to fall into the bag attached to the under side of the apparatus. This invention was patented in 1866, by Mr. George A. Howe, of Brooklyn, N. Y.

Figure 13 represents a pneumatic picker applied by hand, the hose being connected with a fixed exhaust fan or pump. This is one of several similar inventions patented by Mr. John Griffin, of Louisville, Ky. The patent was issued in 1866.

two later. The picking continues at intervals or continually according to the thirst and energy of the farmer until winter sets in or the crop is all gathered.

The more serious obstacles to mechanical picking arise from the irregular height and spacing of the plants; the irregularity in the maturing of the bolls; the necessity of avoiding injury to the plants in the earlier gatherings; the difficulty of withdrawing the ripe lint without admixture with husks, stems, and broken leaves.

The problem is a complicated one, yet it cries aloud for solution and promises a liberal reward to any who shall solve it wholly or in part. If comparatively simple and inexpensive, the successful machine will bring a speedy fortune to the inventor, prosperity to thousands of small planters, occupation for multitudes of mills, and cheaper clothing for half the world.



PNEUMATIC COTTON PICKER.

ON THE CAUSE OF THE ARID CLIMATE OF THE WESTERN PORTION OF THE UNITED STATES.

By CAPT. C. E. DUTTON, U. S. Geological Survey.*

MANY questions arising in the study of Western geology involve the consideration of the arid climate of the region, and I have frequently been led to inquire as to its cause. Arid climates are usually attributed to the passage of prevailing winds over high mountain chains. As they ascend the mountains upon the windward sides they are cooled by the expansion due to diminished barometric pressure, their capacity for moisture is reduced, and an abundant precipitation takes place. Descending up on the leeward sides these changes are reversed; the air is heated, its capacity for moisture is increased; it becomes dry, and having been depleted of moisture, is supposed to be incapable of yielding a copious supply to regions beyond. This explanation is, no doubt, good for some localities. Peru is a case in point, and for that country it seems quite perfect. It is believed by many that it also explains the arid climate of the Western half of the United States, and that the Sierra Nevada is the range which robs the winds of that region of the moisture which otherwise would make its vast expanse fertile. Reflection upon this case has led me to a different conclusion.

It is unquestionable that the Sierra Nevada abstracts a notable amount of moisture from the winds blowing from the Pacific. Mr. B. B. Redding, the land agent of the Central Pacific Railroad, has kept for several years excellent records of the rainfall at many stations in California and Nevada, and informs me that along the main road from Sacramento to the summit pass of the Sierra, the annual rainfall increases at the rate of one inch for every one hundred feet of altitude. At the summit the mean annual precipitation exceeds ninety inches. It is not probable that this large amount is considerably exceeded at numerous points along the crest of the range. It seems clear, therefore, that the winds which blow over the Sierra are to some notable extent depleted of moisture, and the effect must be to at least aggravate the aridity of the regions lying immediately east of the range. But I think it can be made evident that this effect is relatively not great, and that the elevated region of the West would be on the whole very nearly as arid as it now is if the Sierra Nevada were obliterated as a mountain range. Nor can the other and lower ranges lying East of the Sierra affect the case materially, for surely more than ninety per cent. of the rain and snow which fall upon them are re-evaporated in *locus*, and the atmosphere ultimately suffers no material loss of moisture.

When the winds blow constantly from a cool to a warmer region they become warm, and therefore dry; and if they have no opportunity to take up more moisture on the way the passage from a cool to a warm region is a sufficient cause of aridity. This is, I conceive, the state of affairs which determines the climate of the western mountain region. The winds blow constantly from the western quarters, being the "return trades." Local winds and perhaps large cyclones occasionally turn the weathercock toward an easterly quarter, but the general drift of the great atmospheric ocean is ever from West to East.† This prevailing air drift comes from the Pacific, and reaches the coast nearly or quite saturated with moisture. The quantity of moisture required for saturation is dependent chiefly upon temperature; and the temperature of the air as it reaches the coast is determined by oceanic conditions.

From the Aleutian Islands a confluence ocean-current moves southward, having a breadth of five hundred miles or more, and extending as far southward as the latitude of Cape St. Lucas. Off British Columbia and Alaska it may be regarded as a warm current relatively to the adjoining land. Off the Californias, although its temperature rises notably with its southward movement, it may be regarded as a relatively cool current. On the more northerly shores its effect is to make the climate of the adjacent coast warmer than it would otherwise be; and its effect on the more southerly shores is to make them cooler. Stated in another manner, the relation is such that the temperatures of the land areas in the high latitudes are lower than those of the ocean, while in the low latitudes they are higher. In the high latitudes, therefore, the winds blowing from the Pacific are cooled by the land; in the low latitudes they are warmed by it. Hence the precipitation is copious in the former regions and meager in the latter. Between the two belts where these opposite effects are pronounced is a region where they shade into each other, and though this intermediate region cannot be marked out by distinct boundaries it may still be said to exist in latitudes lying within the valley of the Columbia River.

The cause of an arid climate thus indicated may be regarded as generally operative throughout the western mountain region; and it will no doubt appear upon full consideration to be much more potent and widely extended in its action than any or even all of the mountain ranges could be. It is, however, greatly modified by the intervention of local causes, which occasionally mask or obscure it. The precipitation in different portions of the region is highly irregular, and several modifying causes can be indicated, which, though they do not nullify the more general one here set forth, frequently become much more conspicuous in their effects. For instance, it is well known that the heaviest rainfall in the United States, excepting possibly upon some mountain tops, occurs upon the coast of Oregon and Washington Territory. But, as already indicated, this is the locality where we find the neutral axis, so to speak, of the alleged causes favoring respectively humidity and aridity, and where their effects are at a minimum or even at zero. Moreover, the westerly winds saturated with moisture here strike the coastwise mountains, and are suddenly thrown upward several thousand feet before they have had time to feel the heating effect of the land which is here very slight; and the precipitation is thus very copious. Descending to the lower levels inland they soon become dry and produce a sub-arid climate.

The most frequent variants of climate are the great differences of altitude in different portions of the West. The mountain tops and summits of the plateaus are always well watered, and in any given latitude the rainfall increases or diminishes at a fairly definite rate with the altitude. But the variation of rainfall with the altitude is by no means a simple ratio. Between 4,500 and 6,000 feet the difference in rainfall is not great; between 6,000 and 7,500 feet it is very considerable; between 7,500 and 9,000 it is still greater.

Moreover the rainfall is greater, *externa paribus*, in high latitudes than in low latitudes. In passing from the southern to the northern boundary, if we compare localities of equal altitudes along any given meridian, we shall find the

rainfall steadily, though perhaps not uniformly, increasing. This is an obvious consequence of the theory suggested.

Although no very great effects upon the general condition of aridity are here attributed to the depletion of moisture by the passage of the winds over mountain ranges, it is still true, no doubt, that highly important local effects are hereby produced. The rainfall at the eastern base of the Sierra Nevada, and for two hundred miles east of it, is most probably reduced very greatly by this cause. In the sink of the Humboldt River, the annual precipitation seldom reaches four inches, and may average not more than three inches. But as we pass eastward, beyond the *slope* of this range, its effects become gradually less; and long before the Wasatch is reached they have become incon siderable. Since the Sierra Nevada is the longest, highest, and widest of the individualized ranges of the Rocky system, its local effects upon the humidity of the plains and valleys lying immediately under its lee is greater than that of any other. But the same kind of effect is perceptible in some other ranges.

The discussion of the causes of local variations in climate might be almost indefinitely extended. Nothing more is designed here than to advert to one general cause of aridity which prevails over the entire region, and which everywhere exists, though it is often observed, sometimes reversed and sometimes re-enforced, by local causes.—*American Journal of Science.*

AREAS OF INLAND WATERS.

A SPECIAL census report gives the areas of our inland water surfaces, as nearly as can be determined, as follows:

	Square miles.
Rivers and smaller streams.....	14,500
Lakes and ponds.....	23,900
Coast waters (bays, sounds, etc.).....	17,200

In other words 55,600 square miles of the United States are covered with water.

The most extensively watered State is Florida. Its rivers and smaller streams cover a surface of 390 square miles; its lakes and ponds, 2,250; its gulfs, bays, sounds, and like bodies of water, 1,800—in all, 4,400 square miles, against a total land surface of 54,240. Next comes Minnesota, with 360 square miles of rivers, and 3,800 of lakes and ponds. North Carolina has the third place, with 3,260 square miles of coast waters, 250 of rivers and smaller streams, and 160 of lakes and ponds. Texas is fourth, with 2,510 square miles of coast waters, 800 of rivers and streams, and 180 of lakes and ponds. Louisiana is fifth, with 1,060 of coast waters, 540 of rivers, and 1,700 of lakes and ponds. Maine is sixth, with 545 of coast waters, 300 of rivers, and 2,300 of lakes and ponds. Our own State, New York, has only 1,550 square miles of water surface in all, 350 of coast waters, 300 of rivers, and 900 of lakes and ponds. Yet the proportion of water to land is far greater in New York than in Texas. It is 1,550 square miles of water to 47,620 of land, while in Texas the area of the land is 262,290, and of the water only 3,490.

The States and Territories containing the most river surface are:

	Square miles.
Texas.....	800
Missouri.....	630
Nebraska.....	630
Dakota.....	610
Indian Territory.....	600
Washington Territory.....	560
Louisiana.....	540
Arkansas.....	540
Virginia.....	520
Illinois.....	515
Maryland.....	500
Oregon.....	500

Lakes and ponds cover the greatest surface in the following States:

	Square miles.
Minnesota.....	3,800
Utah.....	2,700
Maine.....	2,300
Florida.....	2,250
Louisiana.....	1,700
California.....	1,600
Michigan.....	1,225
Wisconsin.....	1,170
Nevada.....	925
New York.....	900

Of the lakes entirely within the area of the United States the largest are:

	State.	Area.
Tulare.....	Cal.	650
Lake of the Woods.....	Minn.	612
Champlain.....	N. Y. and Vt.	488
Red.....	Minn.	342
Flathead.....	Mon.	318
Carson Sink.....	Nev.	225
Pyramid.....	Nev.	215
Goose.....	Cal. and Ore.	201
Mille Lacs.....	Minn.	198
Winnebago.....	Wis.	197

DREDGING IN THE MEDITERRANEAN.

The good work in zoological exploration done with the French Government vessel *Le Travailleur* last year was followed up this year by another expedition in the same vessel, which, well equipped at Rochefort, left that place on June 9, and after a seventy days' cruise in the Atlantic and Mediterranean, returned on August 9. The expedition was organized by M. H. Milne-Edwards, and the naturalists who embarked were MM. A. Milne-Edwards, De Folin (editor of the journal *Les Flots de la Mer*), and Fischer, and Professors Vaillant, Perrier, and Marion. From a short account of what was done in the Mediterranean, we learn that part of June and the whole of July were devoted to exploring the deeper parts of that sea (largely unknown hitherto). The general result arrived at is that the Mediterranean is not to be considered a distinct zoological province; most of its animals have come from the ocean, and the more we get to know of the animals off the oceanic coasts of Portugal, Spain, Morocco, and Senegal, along with Mediterranean fauna, the more do differences between the two disappear. In the Mediterranean, near the shores especially, species seem often to have a more active growth and reproduction than in the parts whence they migrated, and the new conditions of life have somewhat modified the external characters. Various interesting types of crustaceans, mollusks, bryozoa, coelenterata, etc., were met with, many of them found only in the Atlantic before, some corresponding to fossil forms, some

presenting a transition between oceanic and Mediterranean fauna, and so on. A new species of galathodes (a crustacean largely represented in the Caribbean Sea) was found at 450 m. depth; like its congeners, it is blind. Between 500 m. and 2,600 m. there are found in certain places enormous masses of empty shells of pteropoda and heteropoda. The finding (at depths below 550 m.) of specimens of the splendid sea bri-linga, which has been thought to tenant only the deep and cold parts of the ocean, was quite unexpected. No infusoria were obtained at great depths; there were few rhizopods, and the finest granulations from the bottom never revealed the presence of bacteria or other minute forms of life. Below 60 m. sponges were rare and represented by only two species.—*London Times.*

A CATALOGUE, containing brief notices of many important scientific papers heretofore published in the SUPPLEMENT, may be had gratis at this office.

THE

Scientific American Supplement.

PUBLISHED WEEKLY.

TERMS OF SUBSCRIPTION, \$5 A YEAR.

Sent by mail, postage prepaid, to subscribers in any part of the United States or Canada. Six dollars a year, sent, prepaid, to any foreign country.

All the back numbers of THE SUPPLEMENT, from the commencement, January 1, 1876, can be had. Price, 10 cents each.

All the back volumes of THE SUPPLEMENT can likewise be supplied. Two volumes are issued yearly. Price of each volume, \$2.50, stitched in paper, or \$3.50, bound in stiff covers.

COMBINED RATES—One copy of SCIENTIFIC AMERICAN and one copy of SCIENTIFIC AMERICAN SUPPLEMENT, one year, postpaid, \$7.00.

A liberal discount to booksellers, news agents, and canvassers.

MUNN & CO., Publishers,

261 Broadway, New York, N. Y.

TABLE OF CONTENTS.

	PAGE
I. ENGINEERING AND MECHANICS.—High Speed Steamships. Capt. Lundborg's design.—Estimates. Improved Fuel Feeders. McMillan Apparatus. 3 figures. Sections, etc. High Pressure Filtering Press. System of Berlin-Godot. 1 figure. Quartz Crushing Machinery. Processes.—Mechanical conditions.—Resistive strains.—Methods of resisting strains.—The force expended on the quartz.—The second condition of machine action.—Abrasion.—Percussive machinery.—Wear.—Machining operated by pressure.—Cost of maintenance.—History of crushing machinery.—Hollens.—New Inventions.—Conditions of advance.—Iumbuga, etc. Gold Mining. Description of the Placerville Amalgamation Mill. Amount of gold lost in tailings.—Various opinions. Electric Exploding Apparatus for Mining Purposes. 5 figures. Exploding apparatus.—Method of splicing and covering wire.—Section of percussion cap.—Arrangement of the apparatus for blasting in a shaft.—Block of steel from a 20-ton gun shattered by dynamite and electricity. Practical Notes on Plumbing. (Continued from SUPPLEMENT No. 31A.) By P. J. DAVIES. Figs 54 to 84. Knuckle bends.—Theory of bending.—Knuckle joint set-offs.—Cleaning set-off.—Elbows, soil pipes, and traps.—Soldering elbows.—Soil pipe making, stacking, etc.—Sink traps and their varieties.—Siphon traps.—Various forms of Δ , \square , and V traps.—Working of traps.—Plans, sections, etc. A various Craft. Knots and Splices. 88 engravings of various kinds of Knots and Splices. Knots and Splices. Article describing the engravings on page 503. Knots and Splices. Article describing the engravings on page 503. Lifting Tackle. With 8 engravings. Detection of Gold.	500
II. ELECTRICITY, PHYSICS, ETC.—Equipotential Law and Nobili's Rings. The Optical Requirements for Photographing on a Scale of Nature. Mercury Intensifiers. By COSMO I. BURTON and ARTHUR P. LAURIE.	504
III. ART, ARCHITECTURE, ETC.—The Great Wall of China.—The seaward end of the great wall.—1 illustration. Winchester Cathedral.—1 full page illustration.	509
IV. AGRICULTURE, ETC.—Pistachia Gum. Resistance of Grape Vines to Phylloxera in Sandy Soil. The Cultivation of the Ramie Plant. Meiso. By Prof. D. P. L'ENHALLOW. Lyceopodium, the First Alkaloid of the Vasculer Cryptogama. By KARL BOEDKER. Oil Adulteration. Cotton and its Future.—An opportunity for invention.—10 figures. Machines and appliances for harvesting Cotton.	509
V. GEOLOGY, ETC.—The Causes of the Arid Climate of the Western Portion of the United States. By Captain C. E. DUTTON. Areas of American Inland Waters. Dredging in the Mediterranean.	509

PATENTS.

In connection with the **Scientific American**, Messrs. MUNN & CO. are Solicitors of American and Foreign Patents, have had 26 years' experience, and now have the largest establishment in the world. Patents are obtained on the best terms.

A special notice is made in the **Scientific American** of all inventions patented through this Agency, with the name and residence of the Patentees. By the immense circulation thus given, public attention is directed to the merits of the new patent, and sales or introduction easily effected.

Any person who has made a new discovery or invention can ascertain, free of charge, whether a patent can probably be obtained, by writing to MUNN & CO.

We also send free our Hand Book about the Patent Laws, Patents, Caveats, Trade Marks, their costs, and how procured, with hints for procuring advances on inventions. Address

MUNN & CO., 261 Broadway, New York.
Branch Office, cor. F and 7th Sts., Washington, D. C.

* Read before Section B, American Association for the Advancement of Science, Cincinnati Meeting, August 18, 1881.

† This general statement requires some qualification when applied to Southern Arizona and Southern New Mexico, though it is in the main applicable even there.

